

# The Developmental Steps of Experimental Archaeology in Greece Through Key Historical Replicative Experiments and Reconstructions

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## **Introduction**

Hellenic history, being the longest continuously recorded history of a nation and the one that formed the basis of our modern world, provides an ideal basis for the development of a prominent experimental archaeology sector in the country. Nonetheless, while experimental archaeology in Greece may count almost two centuries of life and some of the most important projects worldwide, it is still far from being called a mature field of knowledge.

Academic historians and archaeologists, in Greece as well as abroad, have largely focused on art philosophy and historiography and less on other more practical aspects of the Hellenic Civilisation. The only field providing standard applications with nuances of experimental archaeology is ancient monument reconstruction, yet, as this is considered a sector of its own, reference will be made only to the first of its kind that initiated the sector. The general lack of interest on archaeology's applications resulted in Hellenic history being presented in a fossilised manner suffering visually and contextually in the hands of less-educated amateurs, propagandists, politicians and filmmakers who presented a distorted view to suit their own ends, often putting off the interest of the general public.

Yet for all the adversity and lack of proper frame of work, Greece presented in the last decades a number of highly interesting projects in the field of experimental archaeology. Individuals and organisations with public and private finance carried out experiments and/or created high quality historical reconstructions testing hypotheses on questions of the past, which had certainly an impact in reversing some of the negative prejudice against the employment of experimental archaeology in the study of Hellenic history.

In this text we, members of Association of Historical Studies KORYVANTES, are pleased to present you a non-exhaustive listing of experimental archaeology work that took place in Greece in the last two centuries. It is a representative selection of the most notable instances, selected to satisfy the scope of discerning the evolution of the field in Greece, as seen from our 'non-academic' perspective. Following the tone set by our introduction, our aim is to provide a concise view of the environment in which that work took place, in order to comprehend better the actual status of experimental archaeology in Greece and thus better promote its employment in future.

## **First examples of experimentation in Greek classical archaeology**

Experimental archaeology in Greece followed the emergence of modern archaeology in the nineteenth century, practiced by early romantic enthusiasts and professional/academic scholars alike, inspired by each unearthed item, triggering the questions 'how' and 'why'. Greece was a main focus of the Romantic movement of the early nineteenth century as the Greek War of Independence rekindled the interest in the study of the ancient Greek World returning classicism in fashion in art, literature and architecture and remaining in vogue through the mid and later part of the century.

Interest initially focused on architectural and clothing styles something which necessarily involved practical experimentation and reconstruction. This was not initiated so much by a will to research thoroughly questions of the past but rather by the aim of producing directly applicable results in contemporary life. If such experimental reconstructions bore contemporary romantic notions of the ancient past, the seed was planted and the quest for historical accuracy had started.

### *The Panathinaikon Stadium*

The existence of the Panathinaikon Stadium in Athens dates back to the Classical Era but the main architectural structure was a thorough refurbishment of the mid-Roman era. Until the nineteenth century, after centuries of natural and man-made destruction, only traces of it existed. In mid-nineteenth century, Evangelos Zappas, organiser of the first modern Olympic Games in 1857 at Athens, financed the archaeological survey of the stadium and the architectural studies having as objective its reconstruction as close as possible to the ancient Roman era structure. Accomplished on plans drawn by renowned architects Ernst Ziller and Anastasios Metaxas, the reconstructed Panathinaikon Stadium was used for the 1870 and 1875 Olympic Games. The stadium was further refurbished fully in marble financed by Evangelos Averov, the state as well as citizens' donations, and it was the epicentre of the first international Olympic Games in 1896 held in Athens.

Although being the result of a political effort to demonstrate to the world the continuous glory of an ancient nation who had recently found again its position in the world, the reconstruction itself was quite remarkable. Zappas, one of the wealthiest businessmen in Greece at the time, was a keen amateur of history and

archaeology, thus he explicitly set the objective of following the ancient structure traces, no matter the costs, resulting in a reconstruction that is acceptable even by today's stricter standards (Miller 2001). The reconstruction of the Panathinaikon Stadium, along with the organisation of Olympic Games plus the repetition of the Marathon run, presented all early nuances of experimental archaeology.

### *The Delphic Games*

The first modern Delphic Games<sup>1</sup> were organised in 1927 and 1930 being the personal work of poet Angelos Sikelianos. Sikelianos aimed at capturing the essence of ancient Games, avoiding the commercialisation and propagandas that already plagued the modern Olympic Games. An interdisciplinary event that promoted multiple angles of cultural activity, the Delphic Games were consciously organised as a platform for experimentation with living history and experimental archaeology featuring prominently. Participants of the theatrical play *Prometheus* appeared in historically accurate clothing performing reconstructed dance steps; there was even a first attempt to reconstruct ancient Greek warriors based on all then available information.

The Delphic Games were generally highly acclaimed by both academics and audiences (Schoener 1966-1967), although they also earned a fair share of criticism. A modern review of that criticism reveals that much of it was actually politically driven, actually arising from the fact that Sikelianos tried to keep politics out of the Games-remarkable effort in an era of ongoing strong propagandas striving to exploit such events. The reconstruction efforts of the Delphic Games may appear today as somehow 'naïve', however that was due to the fact that the available information provided by the academic/scholar research of that time was very limited. In fact, the overall effort was quite admirable and thus it is very unfortunate that the Delphic Games were discontinued due to lack of funding.

### *Archimedes' mirrors experimental reconstruction*

In the post-war era, the first true applications of experimental archaeology were provided by civil engineer Ioannis Sakkas who worked in the 1950s and 1960s in the tracing, reconstruction and testing of the inventions of Archimedes<sup>2</sup>. Among all, Archimedes' mirrors constituted historically one of the most highly debated technical topics with mainstream historiography up to mid-twentieth century being generally dismissive. In the period from 1965 to 1973, Sakkas worked with historian Evangelos Stamatis analysing ancient references and concluding to a simple multi-mirror arrangement handled independently by men. The scenario was put to the test in 1973 with the construction of 130 flat mirrors of 1.7 x 0.7

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1 The ancient games in Delphi were actually called 'Pythian Games'-Sikelianos named the modern ones 'Delphic Games' since, among other reasons, the name of Delphi is more recognisable by the general public.

2 Archimedes (287 BCE-212 BCE), the ancient Greek scientist from Syracuse, is mentioned by medieval Greek engineer Anthemios of Traleis (sixth century), to have produced a number of military defensive devices whose existence was later dismissed by post-Renaissance writers (René Descartes being a notable case).

m, copper-coated as most contemporary third century BCE mirrors would have been, each operated by one man. The target was a small plywood boat painted with tar paint, as was the case of contemporary ships. Sakkas tested his hypothesis with success at different distances of 50 to 100m employing arrangements of 50 to 130 mirrors/men during summer of 1973, then organising a public demonstration in November, in the presence of Greek and international academics, engineers and journalists (Lazos 1995). In spite of unfavourable weather conditions and of having opted for an arrangement of only seventy mirrors/men, the experiment was successful; as soon as most of the men found the correct focus, the boat ignited in seconds.

For all the academic interest and dedicated article publications at that time, the experiment was later forgotten. Unfortunately, while Sakkas himself was not involved in politics and his work on the experiment itself counted more than a decade, the mere fact that it was funded by the Hellenic Navy and performed weeks before the Athens Polytechnic Uprising and months before the Turkish invasion of Cyprus was enough to create the wrong impression. In the following years, Greek academics and specialists not only ignored the experiment but also Sakkas' overall contribution to the field of archaeology (Africa 1975). This phenomenon gave rise to often politically motivated scepticism rejecting the experiment even on baseless statements such as accusing Sakkas of using modern mirrors and of painting the boat with tar to accelerate ignition. Such statements were eventually recycled outside Greece, mounting in a scientifically ambiguous repetition of the experiment in 2004 by Massachusetts Institute of Technology (MIT) (Archimedes Death Ray 2005). This though, had the positive side-effect of raising discussion, internationally prompting anew academics and researchers to study the topic re-evaluating the work of Sakkas and restoring him to his rightful place as one of the main proponents of experimental archaeology worldwide and as the first true experimental archaeologist in Greece.

## Naval reconstructions

Nautical reconstructive archaeology is one of the most complex and expensive applications of experimental archaeology, certainly not the exercise of countries allocating low budgets for that kind of archaeological research. Nonetheless, in the last three decades, the Greek state repeatedly made the decision to finance some very exciting such projects. The bond between the Greeks and the Sea, after all, is as old as time itself. That by itself, prompted eventually the reconstruction of a number of ancient Greek ships shedding light in the till recently little known maritime technology of antiquity. The projects, particularly *Keryneia II*, *Olympias* and *Argo* were of considerable size, in terms of finance, manpower and testing means and were characterised by the inclusion of international teams. If ancient ship reconstruction proved to be a time/resource consuming effort, the management of politics and the projects' post-test life-cycles proved to be the most important parameter, defining the measure of projects' success.

## *The Keryneia II: Hellenistic era merchant ship reconstruction*

The 'Keryneia ship' is the name given to a small ancient Greek merchant ship of the late fourth century BCE whose shipwreck was discovered by sponge diver Andreas Kariolou in 1965 a few kilometres off the port of Keryneia in Cyprus. Kariolou informed officials who in turn organised an elaborate expedition led by US specialist marine archaeologist Michael Katzev. By 1973 the shipwreck was fully extracted and re-assembled identically within the Keryneia Shipwreck Museum. It was arranged for the purpose of enabling further research, yet, before it was fully refurbished, it fell victim to the 1974 Turkish invasion. The disaster threatened even the very survival of the shipwreck after the refusal of the occupation force to accept the introduction of specialist machinery on the grounds of refusing entry to Greeks. The affair raised the urgency of producing and maintaining a copy of the shipwreck in case of accidental/voluntary loss of the original.

The case took a positive turn in 1978 when a full-scale reconstruction was proposed by experimental researcher Haris Tzalas, founder of the Hellenic Institute of Nautical Tradition Protection, who had closely followed Katzev's work. The importance of the reconstruction of ship laid not only upon the fact that this would be a first for an ancient Greek ship, but mostly on the fact that the Keryneia ship was then the only example of an ancient Greek shipwreck excavated with a substantial part of the ship remaining that could be studied in depth. The proposal won the support of the governments of Greece and Cyprus, motivated by all means more by political-cultural concerns rather than by purely experimental archaeology ones as the ship, after completion of its experimental testing, would be used to promote Greek culture internationally.

The construction of the ship, named *Keryneia II*, took place from 1982 to 1985 in a traditional shipyard at Perama, Athens, following the layout plan of renowned US marine archaeologist Richard Steffy (1985) who had worked along with Katzev on the shipwreck. *Keryneia II* was constructed under the strictest experimental archaeology methodology, using exclusively techniques of the era by a workforce specialising in traditional vessels. Following precisely the characteristics of the ancient ship, the construction followed the 'shell-first' method producing a vessel measuring 14.75 m – 4.30 m and 30 t. Sea trials took place in early-mid-1986 and on 6 September 1986 the ship set semi-loaded from the port of Piraeus to reach the port of Pafos in Cyprus. The ship was sailed employing ancient 'sun and stars' orientation methods by two alternating teams of a captain and four sailors to both maintain the original crew number and increase the number of people gaining experience on the ship. The ship sailed the Aegean, doing multiple stops in major islands, arriving on 2 October in the port of Pafos, having covered more than 1200 km in 25 days. The length of the trip was down to those stop-overs and testing rather than the ship's performance, one that actually surprised both crew and archaeologists, having attained easily average speeds of 4 to 5 kn under semi-favourable conditions and surpassing at times the 12 kn under strong winds.

Overall, that first voyage of *Keryneia II* to Pafos and its return voyage to Piraeus yielded an abundance of data on the original *Keryneia* ship, its design, functions, performances and handling. Replaced in 2002 by *Keryneia Liberty*, a

new replica constructed for further navigational testing, *Keryneia II* is now part of the collection of the Municipal Museum of Agia Napa, Cyprus since 2005. The experiment proved highly successful as the project moved beyond the unfortunate background story and all surrounding political issues, to become a prime example worldwide of nautical experimental archaeology experiment producing the first tangible evidence on the performances and handling of ancient Greek sail ships—a testament to the efforts of Katzev, Steffy and Tzalas (Katzev 2008; Katzev and Katzev 1989).

### *The Papyrella project on early Neolithic Era sea vessels*

Another experimental archaeology project undertaken by the Hellenic Institute of Nautical Tradition Protection, initiated by Haris Tzalas, was a study case of the maritime capacities of Aegean societies of early Neolithic Era (10,000-6,000 BCE) resulting in the testing of an experimental reconstruction. The issue rose by the finding inside the cave of Franchthi, near Argos, of obsidian items originating from the island of Melos and dating back to early Neolithic—fact that implied early seafaring. Several hypotheses were studied but one case drew Tzalas' attention, the Papyrella of Corfu. These so-called 'papyrella' boats are simple vessels traditionally made by tying packs of papyrus plants with rope to form a floating platform still used in our times occasionally by farmers. This primitive design of a vessel that persisted through the ages as the cheapest way to construct a temporary vessel offered a fully realistic example of what could have Neolithic mariners been using.

The reconstruction took place in early 1988 in collaboration with professor Augoustos Sordinas and mariner Anastasios Tzamtzis. It employed materials and techniques available in 10,000 BCE and produced a papyrus boat of 5.75 m, which was then tested in sea trials during summer. On 8 October 1988, the boat was put to the test by a team of six kayak athletes supported by a team of experts, accomplishing in parts the voyage from Attica to Melos. The experiment's success was to develop a totally realistic basic arrangement that could have easily existed with the means/techniques of at least the early Neolithic and prove that such a trip was totally feasible without of course purporting that such an arrangement was necessarily the one used back then (Tartaron 2013).

### *The trireme Olympias reconstruction*

In the early 1980s, along the reconstruction of *Keryneia II* another important nautical experimental archaeology project was taking off, one concerning the quintessential military ship of the Classical Era, the trireme<sup>3</sup>. The project was initiated in United Kingdom after a long public exchange of letters between academic historian John Morrison and naval architect John Coates who along with writer Frank Welsh went on to found the Trireme Trust in 1982. The project aimed

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3 The trireme was an ultra-fast ancient Mediterranean military ship integrating three rows of overall one hundred and seventy rowers and employing a ram in the front for the ramming of enemy ships – it had been the mainstay of the Greek navies from the late Archaic to late Hellenistic times (sixth to first century BCE).

to investigate a centuries-old question on the nature of the ancient warship on which there are currently almost no physical findings except from small metallic parts. Work focused in proposing layout plans for the reconstruction and these were proposed to the Greek government which gave its approval with the Hellenic Navy financing the project and honorary introducing the ship as part of its military fleet.

The trireme, named *Olympias*, was constructed in the Perama shipyards at Athens between 1985 and 1987 using methods and techniques of the era executed by a workforce specialised in traditional boat construction. It is noteworthy that *Olympias* benefited by the first conclusions derived by the *Keryneia II* that had already been completed and was being tested. *Olympias* was constructed as an example of how a typical fifth century BCE Athenian trireme should have been like, with 36.90 m length, 5.50 m width and a tonnage of 70, manned by a crew counting one hundred and seventy rowers (Morrison and Coates 1986). As this was an international project, rowers were invited mainly from abroad, mostly from the UK where the Trireme Trust is based. *Olympias* was inaugurated in August 1987 and for the next 6 years it underwent a series of sea trials in the Saronic Gulf outside Attica and up to the nearby island of Poros. The short voyages were conducted with alternating and combined use of sails and oars so as to perform a series of series of experiments testing a long list of hypotheses on the use of triremes. Tests determined the strength, the cruising characteristics (speed data) as well as the crew's living conditions and increased understanding of the tactics employed in sea battles.

The overall experiment, an international effort, and the largest project of its kind so far, was highly successful. It highlighted the construction and usage of ancient triremes and in general the achievements of ancient Greek maritime technology (Coates, Platis and Shaw 1990). Along with *Keryneia II* it provided a definitive answer on the question of performances that troubled historians for the last two centuries-particularly that of cruising speed. *Olympias* testing showed that a totally inexperienced crew on its first trials on board a reconstructed experimental ship on which even maritime specialists had little clue managed to get average and maximum speeds that are quite comparable to nineteenth century sail ships, implying that ancient ships had in fact superior performances, verifying ancient writers' references of average cruising speeds.

Beyond the experimental archaeology nature of the project, the reconstructed ship itself became a cultural showcase for both Greek and British partners, both interested in promoting their position as maritime nations. The ship participated in athletic events and cultural celebrations including the Athens Olympic Games of 2004 and became the theme of several British historical documentaries dedicated to ancient Greek maritime technology and/or to ancient Greek history in general. Since 1994 and the end of the sea trials, the Trireme Trust is dedicated to disseminating information on the ship through publications, lectures and television programmes continuing research based on the accumulated data, while the ship itself has become a permanent exhibit in the port of Phaliro.



### *The pentecore Argo reconstruction*

The success of *Keryneia II*, *Keryneia Liberty* and *Olympias* reconstructions had a considerable cultural impact in Greece raising the interest of many individuals, organisations and governmental agents for such type of projects. The project *Argo* was inscribed in that trend being promoted by an interdisciplinary team led by expert mariner Apostolos Kourtis who set the Institute of Ancient Shipbuilding Research and Technology (NAFDOMOS). Their proposal was on the experimental construction of a realistic suggestion of a 'Bronze Age pentecore', one that sailed in the era of Jason and the Argonauts<sup>4</sup>. In 2003 the Municipality of Volos-the modern city near Iolkos, Jason's city-undertook the hosting of the Mediterranean Games of 2013 and eventually agreed to sponsor the project as a combined experimental / educational and cultural one. Analysing all existing elements, the team concluded to a design of a fifty-oared penteconter of the continental naval school typology which was constructed at Volos, in 2006-2007, employing traditional materials and techniques, notably persisting on usage of locally produced materials. The 28.50 m – 4.20 m, 45 t penteconter named *Argo* after Jason's legendary ship, was inaugurated in early 2008 raising public interest with the announcement of a plan to sail all the way to Georgia where Jason is said to have travelled.

From there on many problems arose. The Turkish state forbade access through Bosphorus on alleged safety concerns. Even more critical that summer was the situation in Georgia, which was at the brink of war. The Greek government also increasingly saw the project as an unreasonable exercise undertaken by a medium sized city like Volos. Academics too lost interest, perceiving the project more as a cultural showcase for the 2013 Mediterranean Games than as a pure experimental archaeology project, criticising particularly the choice of a vague subject to reconstruct. The team defended the project, deciding to cover the equally long return path of the Argonauts, circumnavigating Greece and sailing up to Venice. *Argo*, surprisingly manned largely by an inexperienced crew, amateurs of history and students, set on in June 2008 for a two month voyage, accomplishing the round of mainland Greece into the Adriatic and reaching the port-town of Agioi Saranta, before the expedition was ordered to return by officials (for what reason is still not yet fully clear).

No matter its complications, the project *Argo* is a notable project of experimental archaeology nature. It complemented the data recorded by the previous projects of *Keryneia II* and *Olympias* verifying average and maximum speeds. Most importantly, it offered a vastly richer experience in terms of 'working and living' on such a type of ship for a prolonged period of time. *Argo* still holds the record of the longest continuous voyage of an ancient Mediterranean experimental ship reconstruction, having experienced a rare summer storm and rough times even without escort ships. That these achievements were brought by the most inexperienced crew that ever sailed on a reconstructed ship is a remarkable fact showing the capabilities of

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4 The penteconter is one of the most ancient ship designs mentioned too in Homeric texts thus most possibly existing since mid-second millennium BC, the era when Jason and the Argonauts sailed the Black Sea.



ancient ships. Following return to the city of Volos, the Association of Oarers of Argo set up a structure for the recording and dissemination of the accumulated experiences from *Argo's* voyage, while the ship itself is currently exhibited in the port of Volos, taking part in educational documentaries and cultural events.

## **Open-air museums**

Greece is a country that offers some of the most ideal places and themes for the realisation of open-air museums, yet open-air museum applications in Greece are limited to the outside yards of ethnographic/folklore museums which usually contain maintained original pieces of recent centuries rather than reconstructed exhibits of previous historic eras. A rare exception to that rule is the Open-Air Museum of Dispilio in the region of north Macedonia.

### *The archaeological open-air museum, Dispilio*

Dispilio is the site of a Neolithic Era lakeside village, situated on Lake Orestias, nearby the city of Kastoria in Macedonia, discovered by professor Antonios Keramopoulos in 1932. In 1974 professor Nicolaos Moutsopoulos recorded a large number of wooden poles and collected stone tools. Systematic excavations started in 1992, by Neolithic expert Georgios Hourmouziadis professor of Prehistoric Archaeology in the Aristotle University at Thessaloniki. His discoveries included a long list of ultra-interesting findings among which the most spectacular one has been the Dispilio tablet, a wooden tablet bearing an inscription, dated to 5250 BCE which remains the subject of ongoing work (Hourmouziadis 2002). As the Dispilio settlement remained continuously populated through the millennia, there have been found Bronze Era remains that are of a distinctively Mycenaean culture, which, along the findings at Aiani, establish formally the region of Macedonia as an integral part of the Mycenaean world.

As soon as the systematic excavations started, the team faced repeatedly the need of employing means of reconstructive experimental archaeology to test hypotheses to acquire a better understanding of the findings, primarily those related to housing. That need, in conjunction with the need to promote all work on what is one of the most important Neolithic sites worldwide, led to the development of the Dispilio Eco-museum. It was developed in 1997-1999 as an open-air museum, under the guidance of Hourmouziadis' archaeological team, reconstructing lakeside and land dwellings, utensils and boats following findings, offering a multi-dimensional portrayal of the settlement that once stood there. As professor Hourmouziades noted, the Dispilio Eco-museum is not promoted as a 'scientific conclusion' or as a 'Neolithic park' but as a purely experimental site, open to public, fostering further archaeological research. The Dispilio Eco-museum serves also as a hub for the Dispilio Excavations' Volunteer Team comprising of members participating in both excavations' and museum's activities.

Considering its original scope, Dispilio Eco-museum is certainly a successful effort and a rare example in Greece of a true open-air museum with an active involvement in the field of experimental archaeology. Nonetheless, it is also true



*Figure 1: Reconstruction and testing of Classical Period archer equipment by Association KORYVANTES (Photo: Andreas Smaragdis)*

that the museum's finance was provided more as a one-off. The site's position away from the country's big cities and touristic regions and its reference to the unknown Neolithic Era resulted in the attraction of a moderate number of visitors, no matter the relative public awareness of the Dispilio tablet. While the latter could be used in promotion, it would contradict the archaeological team's objective of focusing on the experimental part of the project.

### **Experimental reconstruction of ancient technology achievements**

In parallel to resource-intensive projects, a number of experimental researchers focused in the reconstruction and testing of ancient technological achievements. These experimental reconstructions play a pivotal role not only in educating specialists and public on the level of technological advance in antiquity but also in

changing opinions tearing down lingering misconceptions about ancient Greeks being great at theory but mediocre in its practical applications. This is a field where input of experimental archaeology in Greece has already played a pivotal role.

Aforementioned Ioannis Sakas (civil engineer) is certainly the most celebrated of all experimental researchers, having had as a life-goal the tracing of Archimedes' works producing full-size or scaled reconstructions of his inventions for actual testing. Following his footsteps, a number of scientists and academics have been occupied with reconstructions of ancient Greek technological achievements. This list includes Dionysis Kriaris, (mathematician), Nikos Orfanoudakis (aircraft engineer), Dimitris Kalligeropoulos (professor) and Kostantinos Kotsanas (engineer), all of which have produced a very long list of reconstructions, ranging from orientation tools and hydraulic clocks to musical instruments and military engines, notably also of those least studied eras of Hellenic history such as the Byzantine and Mycenaean Era.

### *Archimedes' steam canon*

In their research of Archimedes' inventions, engineer Ioannis Sakkas and technology historian Evangelos Stamatis studied experimentally (among others) Archimedes' steam canon, as this is known via the texts of Renaissance artist/engineer Leonardo Da Vinci who referred to medieval Greek documents attributing the design to Archimedes. Archimedes' steam canon (Chondros 2010), like Archimedes' mirrors, constituted an issue of heated discussion for several centuries.

Stamatis had estimated that the cannon described in Leonardo Da Vinci's notebooks had dimensions that could propel a 36 kg object at a distance of 1.2 km (Simms 1988). To test the hypothesis, Sakkas created in 1980 a 1:5 model of it, of 65 cm overall length. It consisted of a brushwood fire heater integrated at the bottom-end part of the canon's barrel, into which a small quantity of steamed water up to 10 gm was poured in via a manually operated valve. In the canon barrel, a tennis ball-sized 3 kg projectile was loaded being kept inside the tube by a single-use external wooden stopper; when steam with the right pressure was injected, the stopper was breaking, thus releasing the projectile. Sakkas and Stamatis organised in 1981 a public test in an open field in Ano Vrylissia, Athens, in presence of Greek and international media. Sakkas operated himself the model setting the heat to 400° C, pouring a mere 6 gm of steam which was enough to break the beam and propel the ball to a distance of 50 metres. Based on this, Sakkas established that a full 1:1 version of Archimedes' steam canon would project much heavier projectiles over a distance of several hundred metres.

The experiment was hailed as a success and was widely reported in the press at the time, however soon, the type of criticism on the previous experiment on 'Archimedes' mirrors' appeared. Much of it revolved around arguments over the range and choice of stopper ignoring that Sakkas' objective was to conduct an experimental archaeology test to check whether such a canon built with materials and techniques existing in the third century BCE could had been feasible (Simms 1987). Such criticism again was recycled in popular media when the US television programme *Mythbusters* referred in 2006 again to the MIT team that developed

and tested two scaled versions of the canon, one said to be close to Sakkas' arrangement, and another 'simpler one', not disclosed for public safety reasons. Both arrangements performed equally well. MIT's team verified Stamatidis calculations by also giving a range of 1.2 km and concluded in accordance with Sakkas that such canons were totally feasible with materials and production techniques of the third century BCE.

### *The Antikythera mechanism – Dionysis Kriaris*

The Antikythera mechanism, currently considered to be one of the most important archaeological discoveries of all times and the most complex archaeological finding to date, was found in an ancient shipwreck off the coast of Antikythera, discovered in 1900 by sponge diver Ilias Stadiatis and captain Dimitrios Kondos. The following year both of them worked with the National Education Ministry's team that performed the extraction of artefacts including the mechanism, led by archaeologist Valerios Stais. Stais accurately identified it as a clockwork mechanism used as a data-storing device for calendar calculations. However, the cultural bias of the times precluded any suggestion of such advanced technology, being supposedly 'prochronistic' for the shipwreck's date of first century BCE. Criticism against the conclusions of Stais went so far as to even suggest far-fetched scenarios of the mechanism supposedly being a post-Renaissance contraption, accidentally falling in the shipwreck's area.

The Antikythera mechanism was thus stored in the Archaeological Museum of Athens enjoying little research. Stais' conclusion was eventually verified more than half a century later, in 1974 when physicists, Derek Price and Charalambos Karakalos attained the same conclusion having analysed with X-rays the invisible interior of the mechanism finding the existence of eighty-two gears that recorded astronomical calculations with a remarkable accuracy. Their seminal paper is listed as one of archaeology's greatest moments re-writing history and correcting our understanding over the technological and civilisational level attained by ancient Greeks at the end of the first millennium BCE (Price 1974).

The work of Price and Karakalos on the mechanism's internal architecture provided the blueprint for a large number of reconstructions internationally among which some of the most notable are those of mathematician Dionysis Kriaris constructed and exposed in Greece and abroad. Kriaris' reconstructions are notable not only for following closely all latest ongoing research but also for offering a convincing visual aspect that is as close as possible to the ancient mechanism. Kriaris has also produced examples of the mechanism that are without casing so as to permit observation of its interior; such examples are used in the ongoing research of the mechanism. Working with all latest updates provided by The Antikythera Mechanism Research Project, a joint program between Greek, British and US universities and technology firms, Kriaris has developed so far three full versions of the Antikythera mechanism: in 1999, in 2007 and a latest in 2008, which includes the recent confirmation of two additional gears.

### *Ancient Greek technology studies and expositions*

A pivotal role in this particular field of experimental archaeology is played by the Association of Ancient Greek Technology Studies (EMAET), founded in 1993 and currently part of the Technical Chamber of Greece (TEE). EMAET is, essentially, a non-governmental association whose main scope is to promote all ongoing research work related to the subject of ancient and medieval Greek technology. It organises open scientific sessions, lectures, seminars, presentations of books and films, fostering the employment of experimental reconstruction in this specific field (Kazazi 2006). It also organises expositions on ancient and medieval Greek technology such as the one within the Science Centre and Technology Museum (NOESIS), in Thessaloniki.

A notable case of a permanent such exposition is the Museum of Ancient Greek Technology operating in the town of Katakolo under the auspices of the Municipality of Pyrgos. The museum houses the work of accomplished by Kostas Kotsanas, through 22 years of extensive research and study. Kotsanas worked solely based on the thorough study of ancient Greek, Latin and Arabic literature, vase painting information and all existing relevant archaeological finds to reconstruct models or full versions of ancient Greek technological applications ranging from the robot-servant of Philon to the cinema of Heron and from the automatic clock of Ktesibios to the Antikythera mechanism covering a period from 2000 BCE until the end of antiquity (Kotsanas 2011). The collection is the most comprehensive exhibition of its kind worldwide and it is notable that all the exhibits and their supporting material have been created by Kotsanas without any subsidy from any public or private institution.

### **Experimental reconstruction of ancient/medieval Greek warfare**

Considering the effort attributed to reconstructive experimental archaeology in Greece, the ancient Greek warfare should have been a major theme. No matter the early beginnings dating back to the Delphic Games of 1927, there was never established any proper framework for research with academic community remaining largely indifferent. Ancient Greek warfare did not attract interest while medieval Greek warfare remained largely ignored. This situation persisted internationally too until the 1960s when the work of pioneers like Peter Connolly rekindled the interest. By the end of the twentieth century, though, ancient warfare reconstruction in Greece remained either the pastime of dedicated amateurs/collectors or the hobby-horse of marginal politico-religious groups brushing with living history for all the wrong reasons, alienating general public and academic community alike.

Association KORYVANTES was founded in 2009 by people with a background in the study of ancient Greek warfare who were not satisfied by the level of reconstruction undertaken so far in Greece and internationally and who wished to ultimately adopt a framework based on experimental archaeology methodology and test established and new theories in ancient and medieval warfare. The Association, comprising of amateurs from various professional and academic





Figure 2: Reconstruction of Classical and Hellenistic Period armours and weaponry, by Association KORYVANTES (Photo: Andreas Smaragdis)

backgrounds, undertakes painstaking studies of academic archaeology papers and latest archaeological research, implementing deductions in construction of 'battle-ready/museum-quality', fully tested for validation of functionality/performance. A key direction for the Association is the development of a unique intellectual property on ancient/medieval Greek warfare, shared among all interested parties and for all types of utilisation: academic, experimental, educational, technical and athletic.

### *Experimental reconstructions – Ancient Greek armours and drills*

In the period between 2011 and 2013, KORYVANTES Association undertook in collaboration with the independent researcher on ancient Greek and medieval military technology Dimitris Katsikis, the first systematic effort for the high quality reconstruction of a series of ancient Greek armours ranging from Mycenaean down to Hellenistic era. The reconstructions were built in line with an experimental archaeology methodology, involving full research and justification of design and a hand-made construction employing materials, tooling and techniques of the era (Bakas 2012). The aim was to produce armours that could truly function in 'real battle conditions' thus rigorous testing was carried out with materials and assemblies subjected to all kinds of ill treatment to check durability and functionality. The armours were worn by individual members of the Association in varied weather conditions and in proper training including weaponry-handling

and callisthenics, so as to fully demonstrate their performance. Three notable examples can be provided: the Linothorax, the Dendra suit of armour and the 'Sea-Peoples' armour.

Linothorax is a class of either fully non-metallic or metallic composite armours popular in the Classical-Hellenistic era. The endeavour of linothorax reconstruction undertaken by the Association in 2011 differed from 'magery-obsessed' past attempts realised in Greece and worldwide, resulting in a more realistic reconstruction of three-dimensional visual aspects, offering true functional performance in terms of both protection and agility proven in field tests. Results have been published in the Greek press and the experiment was widely noticed internationally having an impact (Katsikis 2010). In 2012 – 2013, the Association presented the reconstruction of two Bronze Age armours; the Dendra armour, that is the oldest fully-extant amour specimen worldwide, dating back to early fourteenth century at latest, plus an interpretation of a panoply worn by 'Sea-Peoples' appearing on a depiction at Medinet Habou, Egypt dating back to the twelfth century BCE. Dendra armour is a complete suit of armour leaving few things to speculation, while the depiction-based 'Sea-Peoples' armour required interpretation. Differentiating from past 'stereoscopic' attempts and reinforced by related findings in contemporary Mycenaean tombs in Argolis and Boeotia, researcher D. Katsikis proposed an articulated composite bronze armour that resembles being an evolution of the Dendra armour. Members of the Association, tested these impressive armours in 'battle conditions' including long marches and martial drills wearing them for several hours so that each armour's usability and its effects on the human body could be determined, thus obtaining a more insightful view over Bronze Age and Classical Era armours' agility, comfort and associated fighting styles.

In military reconstruction, field-testing and contextual research of armours and weaponry are the most important part of the endeavour. Association KORYVANTES set a proper frame of work involving comprehensive training in monthly group exercises developing the members' abilities with their reconstructed gear. Key persons for this endeavour were Stefanos Skarmintzos, who conducted an extensive research in the area of ancient Greek military training, and Athanasios Barkas, a skilled martial arts trainer with extensive experience in the area of close combat fighting techniques (Pancration). Training, technical guidance and usage of appropriate reconstructions offered the right platform for a series of realistic experiments on ancient formations, such as the hoplite phalanx. Group movement and manoeuvres were practised to check reconstructed weapons' handling in the limited space of a dense formation and deduct the set of 'possible/ not possible' considering the mechanics of movement of a group of people abiding to maintain formation at all times. Some of the conclusions verified ancient references such phalanx's tendency of 'shifting to the right' while others nullified long-held views like the suggested use of spears on phalanx impact.

In conjunction with hoplite infantry drills, in summer 2012, the Association included the formation of a traditional archery team. The archers train with reconstructed ancient and medieval Greek bows and arrows, as well as those of



cultures with which Greeks interacted, including usage of reconstructed copper and bronze arrowheads based on archaeological findings. In 2013, during drills, the members of the archery team executed bow shooting by groups in various distances and against various targets. Testing involved usage of heavy hoplite-shields ('hoplite-archery') and small archery-shields as well as wearing some of the reconstructed armours ranging from the Mycenaean down to the Hellenistic and Byzantine ones, employed in shoot and move drills offering deeper insight in the fighting methods of bow-armed armoured fighters of antiquity.

### *Experimental reconstruction – promotion and popularisation*

In the few years of its existence, the Association KORYVANTES has already succeeded in reversing some of the negative public image of ancient warfare reconstruction, having rekindled too the interest of a number of academics in the field as well as attracting the spotlight of international media, reaching out to the general public and promoting a better understanding of ancient/medieval Greek warfare. KORYVANTES Association envisions affirming its role as part of the field of experimental archaeology not only by means of its core activity but also by means of being a prime popularisation 'channel'. The Association has actively sought ways of promoting work in the field of ancient/medieval Greek weaponry research, reconstruction and testing. It presents its own studies and articles on a monthly basis in the specialty press and organises yearly field-presentations in open-air museums around Europe with the event in Biscupin, Poland in 2011 and Lyon, France in 2012 being prime examples. It also provides advice and visual material to other organisations that require aid. Among other activities, the Association KORYVANTES participates in a number of international mass media productions for the account of channels such as BBC, ITV and History Channel, forwarding the popularisation of Greek warfare field research to a wide international audience ranging from children to mature audiences.

## **Conclusion**

Experimental archaeology in Greece has already accomplished a lot in the span of a few decades presenting a large number of very important and often highly complex projects. However, the aforementioned examples in previous chapters already set the tone indicating that the reality is more nuanced, with both academic and amateur experimental archaeologists operating in a particularly complex environment presenting several challenges that go beyond the perennial lack of constant funding. Experimental archaeology in Greece has been performed more often by specialist amateurs of scientific/engineering maritime/military backgrounds than by academics. More importantly, experimental archaeology, even when performed by fellow-academic specialists has been unable to maintain the interest of overall Greek academic and scientific community, which still perceives such an activity at best as an expensive application of low scientific return or at worst as a marketing exercise of state/private sponsors. Particularly academic archaeologists find



*Figure 3: Reconstruction of Archaic Period armour and weaponry, by Association KORYVANTES (Photo: Andreas Smaragdis)*

it hard to talk of experiments when classical archaeology remains permanently underfunded in what is the country with the highest number of archaeological sites in the world.

In spite of the lack of constant funding for experimental archaeology projects, the typology of projects enjoying state finance is all about costly reconstruction projects of scale while smaller experimental projects are absent or under-promoted. The underlying reasons for that are the very motives of sponsorship focusing in

the political/cultural image aspect and not in the experimental one (Bakas 2010). This pattern is certainly linked to the trend of over-concentration in ‘popular eras’. Perhaps the easiest way to gain acceptance is to mention the ‘magical fifth century BCE’ era while the easiest way to put off interest is to move forward or backward by any period of more than three centuries! These two trends may have sometimes resulted in interesting projects but remain as indicators of a general lack of a stable frame of work, discouraging those academic archaeologists who would wish to enrich their activities by adopting experimental archaeology methodologies.

What therefore the experimental archaeology sector in Greece requires is a proper all-encompassing frame of work. Opening up the sector’s dynamic can be spurred by an organisation laying the frame of work for the execution of projects in experimental archaeology, for both the large state funded ones and the mass of privately sponsored smaller ones. Overall, the basis for development of the experimental archaeology sector in Greece is already pre-existing and whichever path is opted in future, such projects will continue to take place in the country. Greece’s long and rich historic past always has and will always be providing inspiration for academic and amateurs alike to study, research and reconstruct, testing hypotheses. The country’s general public maintains at all times an interest and supports finance of projects whenever these are properly communicated. Whether the sector’s actors will rise to the opportunity of setting up a workable/sustainable framework for the deployment of experimental archaeology projects, is something that remains to be seen. For the time being, the experimental archaeology sector in Greece-for all its successes so far and all the opportunities that lie in future-still has quite some path ahead to cover to reach full maturity.

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