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PAST STONE RESTORATION METHODS IN THE MALTESE ISLANDS

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Abstract

The prehistoric temples of the Maltese islands, built entirely of the local limestone, are today considered as the world's first free-standing monuments in stone. Restoration works were carried out within these temples in the past as the need arose. These works ranged from the simple re-erection of fallen blocks, to the widespread capping of the megaliths of one temple complex with concrete. A number of unique decorations found within these temples were also moved indoors shortly after being discovered. Cracks and fissures were usually filled in with Portland cement or 'deffun', a cement made out of lime and powdered pottery. Iron or bronze dowels were also used on occasions. Surface treatment of weathered stone was also carried out for a number of years. This consisted of the application of linseed oil in paraffin to deteriorating blocks. Unfortunately some of these measures have not only been unsuccessful in treating the original problem, but have given rise to additional problems. These restoration methods have now all been stopped and are being re-evaluated and modern methods of conservation sought by the Stone Research and Conservation Laboratory recently set up within the Museums Department for this purpose.

Introduction

The Maltese islands, strategically situated in the central Mediterranean, occupy an area of only 314 square kilometres. Within this area are the two main islands, Malta and Gozo, besides a number of smaller islets. Both Malta and Gozo are richly endowed with a great number of antiquities, the most important of which are the prehistoric temple complexes built of the local limestone, and the objects, many made of stone, found within them. These temples are now recognised as being the earliest free-standing monuments of stone in the world, having been built, according to calibrated radiocarbon dating, between 3600 and 2500 BC (Renfrew 1972).

The Maltese islands are entirely composed of sedimentary rocks which are for the most part limestones. There is one formation of Globigerina Limestone, a rather soft stone which is very easy to carve (lithologically classified as a biomicrite), and two formations of Coralline Limestone, one above and one below the Globigerina Limestone formation. The Coralline Limestone is generally a much more compact stone (though levels of friable stone also occur) and is also very durable (Pedley et al. 1976). Both types of stone have been used for building since prehistoric times. It is evident that prehistoric man could already distinguish between the two types of stone available locally, using Coralline Limestone to build the outer walls of the temples, whilst employing the softer Globigerina Limestone for inner walls and carved decorations. The use of Globigerina Limestone for building purposes has continued until the present day, unlike Coralline Limestone, the use of which as a building stone has gradually been abandoned.

There are twenty-three classifiable prehistoric temples in Malta and Gozo, of which the more complete and better preserved ones are those of Hagar Qim, Mnajdra and Tarxien in Malta, and Ggantija in Gozo. The form of the temples is quite standard, consisting of a massive external wall, approximately D-shaped, and an internal arrangement of a number of lobes or apses, which vary from three (trefoil or three-apse) to six (six-apse). Two, three or four temples were often grouped together to form temple complexes (Pl. 1). The walls are built of megaliths, weighing up to twenty tons and reaching a height of over 4.5 metres, propped up on end or on edge as orthostats (Trump 1972). Some of the temples were found to contain elaborate stone carvings and artefacts, including numerous stone statuettes varying in size from a few centimetres to the remains of one colossal statue which must have stood about 2.75 metres high when complete. Several of these statues are thought to represent the mother goddess to whom the temples were raised.

Other important stone carvings found in the temples include large decorated blocks which formed an inherent part of the temples and which were found to be particularly numerous in the Tarxien temple complex. These temples were amongst the last to be discovered (M.A.R. 1916, Zammit 1916). Most of the carvings found there consisted of spirals of varying degrees of complexity, as well as representations of animals (sheep, goats, pigs, bulls). More wide-spread are pit-markings which are to be found in several of the temples including those of Hagar Qim, Mnajdra and Ggantija, as well as Tarxien.

Deterioration

The prehistoric temples are subject to two types of deterioration: structural decay and surface decay. Structural decay manifests itself as cracks or fissures, usually in the vertical stones, but sometimes also in the horizontal ones (Pl.2). This may occasionally be attributed to the way the blocks were originally laid. In fact, they can at times be seen to be resting on an uneven base (sometimes even lying on stone rollers used to manoeuvre the megaliths into place and then left lying underneath them). The sheer weight of the block itself, often increased by that of overlying courses, sometimes results in the block splitting. Besides, neglect over thousands of years, accidents and vandalism have all contributed to deterioration of these temples. Another problem occurs when the massive blocks begin to lean rather dangerously, often threatening the collapse of the entire structure. This has occurred in the past in the Ggantija temples, and appears to be occurring more recently at the Mnajdra Temples.

Surface decay, on the other hand, is generally manifest as powdering and/or flaking of the stone surface, or as alveolar weathering. In some cases the temples are situated in coastal areas, where they are under the direct influence of salt-laden air and occasionally quite strong winds. Ground salts also play their part in this destruction. Thus we find that in the two temples closest to the sea (Hagar Qim and Mnajdra) and especially Hagar Qim, which is an exception in that it is entirely built of Globigerina limestone, some of the decorations (pit-markings) which were described some ninety years ago (Mayr 1901) had disappeared about twenty five years later (Zammit 1927).

Restoration methods used in the past

Structural measures

Excavation work at some of the more important temple sites commenced in the mid-nineteenth century (Ggantija: 1827; Hagar Qim: 1839; Mnajdra: 1840). No restoration works appear to have been carried out then. However, the more important finds were moved to the collection at the Public Library (to which the

museum was at that time attached). These included two limestone heads found at the Ggantija Temples in Gozo and a decorated, free-standing altar from Hagar Qim.

In 1885 further excavations took place at the Hagar Qim temples and, as it was then noted that the site was in a much worse state of preservation than it had been on excavation, suggestions were made for its restoration. Some minor works were also carried out and these, together with other major proposed works, were published together with a set of plans and illustrations showing the situation as it appeared then (Caruana 1886).

In 1910 the British School at Rome, under the direction of Dr. T. Ashby, carried out some additional excavations and much needed restoration works at the Hagar Qim and Mnajdra Temple complexes (Ashby et al. 1913). These included the repair of a number of broken megaliths. It is not known with any certainty what was used to fix these broken blocks, but as many of these repairs still exist today, it appears that Portland cement was widely employed. Other works carried out included the propping up of a number of broken table stones (which originally rested on two side pillars) by the addition of a third pillar, built of well-squared smaller blocks, in the centre of the niches housing these trilithons (Pl.3). In no case can the modern addition be confused with the original.

The idea of propping up broken table stones with pillars of ashlar masonry was repeated in the case of the Ggantija Temples in 1937 when a large altar was reconstructed in the Southern Temple, following an accurate drawing made one hundred years earlier (M.A.R. 1937-38).

In more recent years we find that Portland cement was still being used to repair broken or cracked blocks in the megalithic temples. In 1972 a cement grout was used to patch up two badly cracked stones in the Tarxien Temple complex (the stones had been badly damaged by fire, probably during the Bronze Age when we know that the temple was re-used as a cemetary). Unfortunately, at some point it was also decided to insert iron dowels to hold one of the cracked blocks together, and the resulting damage caused by this repair can be seen in Plate 4. At times, instead of dowels, dove-tail joints, filled in with cement, were used to hold together two large pieces of the same block which had broken apart (Pl. 5).

Occasionally, though we do not know exactly when, 'deffun' was used instead of Portland cement to fill in cracks and fissures. 'Deffun' consists of a mixture of lime and powdered or broken pottery. This was generally prepared by the addition of powdered pottery to freshly calcined limestone, using slightly more powdered pottery than lime. This type of cement was used in the Maltese islands in ancient times as a water-proof covering for roofs and for pointing, and is still occasionally employed to the present day, though its use is rapidly dying out.

The most extensive restorations undertaken in the Maltese prehistoric temples were those carried out at the Tarxien Temples. Although many parts of the temple complex were discovered intact, some apses had been completely destroyed when it fell into disuse, and many of the megaliths had subsequently been broken down to make way for the plough. Initial reconstructions were carried out using dry stone walling. However, in 1956, by means of funds donated for the purpose by the Carnegie Corporation of New York, restoration works were carried out on a large scale at these temples, and these were continued until 1959 (M.A.R. 1956-57, 1957-58, 1958-59, 1959-60). Works first commenced on those blocks which were damaged and where cracks in their upper surfaces allowed water to percolate into the blocks. These blocks were capped with 'synthetic stone', a concrete made to match the existing stonework (M.A.R. 1958-59). Work then proceeded to include other blocks which were not seriously damaged, with the aim

of improving the general appearance of the site. In many cases this was done in order to replace the drystone-walling which had previously been used to complete missing apses and broken orthostats. As far as possible, the stones which were repaired were those for which evidence remained of their original dimensions. Where this was lacking, the top of the blocks was left irregular in order to indicate that these blocks were originally higher. In the case of the main entrace, however, the exact height was not known, and only by using calculations based on the heights of other doorways was this arrived at (Trump 1972) (Pl. 6).

The drystone-walling, which had originally been used with some success at Tarxien, was used again at Mnajdra during the 1950s, where large parts of the outer wall which were missing were completed in this way (M.A.R. 1952-53).

The Tarxien temples were not the only ones where 'synthetic stone' was used to repair or face damaged blocks of stone. Other temples, and Hagar Qim in particular, had already been repaired, between 1947 and 1950, using a cement made out of Globigerina Limestone (M.A.R. 1949-50, Evans 1971). Unfortunately here, as also in the case of the Tarxien restorations, we do not know the exact composition of the cement used.

The re-erection of parts of walls or apses using scattered blocks lying close by was also undertaken on different occasions. Included are some works carried out at the Hagar Qim and Mnajdra Temples by the British School at Rome in 1910 (Ashby et al. 1913). However, the most important work undertaken in this respect was the restoration of the facade of the Hagar Qim temples in 1949 (M.A.R. 1948-49). The work here consisted in the reinstatement of a large slab of stone, measuring 2.85m by 2.70m, above the main entrance of the temple complex, and the rebuilding with original blocks two courses of masory above the orthostats forming the facade (Pl. 7). Subsequently this main capping stone was found to have developed a dangerous crack throughout its length and was made secure using bronze dowels (M.A.R. 1957-58). The facade of these temples could be reconstructed with a certain degree of accuracy on the basis of fragments and whole models of megalithic buildings, carved in limestone, which were found at Tarxien and other temple sites, as well as an engraving of the facade of a temple as it must have appeared in prehistoric times, found at the Mnajdra temples.

In the Ggantija temples in Gozo, some minor works involving the re-erection of stone blocks, and the replacement of badly decayed ones, was also carried out as the need arose. When, in the early 1930s, it was noticed that one of the megaliths forming the outer wall of the temple complex was leaning forward dangerously, this was propped up by the use of steel joists. In the 1960s these same joists had to be reinforced as they appeared to be sagging under the weight of the block (Pl. 8).

Measures taken to combat weathering

From the earliest times following the excavations at Hagar Qim and Mnajdra it was noticed that the Globigerina limestone blocks utilised in the building of these temples were deteriorating rapidly, due to adverse environmental conditions. Initially, steps were taken to move the more important sculptured blocks indoors for protection. Besides, the restoration works carried out in 1910 included also the experimental application of silicates to weathered blocks of stone in order to consolidate them (Ashby et al. 1913). Unfortunately, no further details are available as to the type of silicate used, which of the blocks were actually treated or even the mode of application of the consolidant. This seems, however, to have been the only time that silicates were utilised within the prehistoric temples.

In the late 1940s the need was felt once again to apply stone 'preservatives' to decaying stone. It was then decided to use a more 'traditional' method of stone

treatment, that of linseed oil in kerosene (50% of each) applied by brush during the month of July or August, when the stone was considered to be dry enough and hence also sufficiently absorbent to allow such treatment. This procedure was carried out every year until the mid-1970s when expert advice confirmed long-standing doubts as to the usefulness of such treatment.

Other methods of stone treatment have been used in the past in the Maltese islands, though almost certainly not on any prehistoric monument. One of these methods consisted in the application of the juice obtained from the fleshy stems of the indigenous prickly pear plant onto stone to render it water repellent. This was either applied directly by rubbing the stems onto the stone, or else a solution was prepared by chopping up a considerable number of stems and boiling them with a little water; the resulting liquid was applied to the stone by brush. Alternatively, the stem was boiled in linseed oil and the resulting mixture applied to the stone. Undiluted linseed oil was also occasionally used. Another type of stone treatment consisted in the application of an aqueous solution of ferrous sulphate to buildings, especially those in coastal areas (BRE 1958). The reason for the choice of this particular compound is unfortunately not known, especially since its use has been discontinued for decades.

With regard to the elaborate carvings found in the Tarxien Temples, steps were taken a short time after their discovery to protect these decorations. In the late 1920s some of the reliefs which were already seen to be deteriorating were covered by placing slabs of stone in front of them on which were carved copies of the original decorations (Zammit 1927). By 1954 a number of the original carvings, including those bearing animal friezes, had already been placed indoors (in a small site museum built nearby) (M.A.R. 1954-55).

Finally, in 1956, the carved stone blocks which had remained in situ, together with the large stone statue, were moved indoors, as these were also found to be deteriorating. Copies were made either in Globigerina limestone or in concrete and were placed instead of the originals. In the case of the Ggantija Temples in Gozo, where a number of spiral decorations were also found, these were left in place, and only one block bearing a snake relief was moved indoors in 1956 (M.A.R. 1956-57). Numerous pit-marked blocks of stone found in several of the temples, including those of Hagar Qim, Mnajdra and Ggantija, were, however, left in place.

Successes and failures of old restorations

As regards restoration work carried out in the past in the Maltese islands, generally speaking, those measures taken to deal with structural decay were more successful than those taken to combat surface deterioration. This is understandable since it is only in comparatively recent times that we have begun to understand the mechanisms of stone weathering, thus preparing the way for the development of efficient stone consolidants and protectives.

As a result, many of the measures taken in the past in Malta to solve structural problems, such as the insertion of one or two new columns in ashlar masonry to support broken table altars, were in fact reversible. These additions can always be removed if a suitable alternative is found. The problem is more serious when Portland cement, with or without the addition of iron dowels, was used. It is a well known fact that it is never advisable to use Portland cement in the restoration of stone monuments due to the possibility of its releasing soluble salts into the stone, thus accelerating its decay, and due also to its different physical properties. It also has a very low porosity, certainly not compatible with that of Globigerina Limestone, which on average is about 38% (Vannucci et al.

1985). 'Deffun' is a much more porous material, and hence more suitable, but it is not acceptable aesthetically, as its red colour does not harmonise with the honey-coloured stone. It must, however, be realised that both Portland cement and 'Deffun' were used at times when no alternatives were available and broken megaliths had to be repaired without delay in order to safeguard the monument as a whole. The use of these materials in these situations is therefore understandable.

The capping of the blocks with concrete, which took place on a large scale at the Tarxien Temples, as well as reconstructions using original blocks of stone, gave rise to particular structural problems. Following the works carried out at Tarxien, several of the blocks developed deep cracks and fissures (Tampone et al. 1987). Another problem caused by this 'capping' has occurred in the case of two blocks carved in relief, representing two bulls as well as a sow suckling thirteen piglets. When discovered, these blocks were already badly damaged, and when all the decorated slabs at Tarxien were moved indoors, these were left in place as it was considered rather hazardous to move them. These blocks were subsequently capped with concrete during the restoration works carried out in the 1950s (M.A.R. 1957-58). As these were two of the megaliths where the exact height was unknown, the top of the blocks was left irregular. Unfortunately, no attention was paid to the slope of the capping, resulting in an incorrect throw-off of rain water. Consequently, water accumulating at the top of the block eventually flows down the front of the block, over the carved surface. Another problem occurs because the concrete used in the capping is much less porous than the stone itself. Rising ground water cannot evaporate from the top of the block and so moves through the surface of the stone - in this case passing through the already damaged reliefs. All this has tended to accelerate the deterioration of these blocks, so much so that it is seriously being considered whether these blocks should not also be moved indoors and replaced with copies. This will naturally give rise to serious operational problems and risks which will have to be weighed against the advantages to be gained by moving the reliefs indoors.

In the case of the Hagar Qim main entrance, we find that the lintels have deteriorated at a noticeably faster rate since they were covered once more with the presumably original capstone. This is probably due to the introduction of new stresses in the lintels, resulting in the production of microcracks, which lead to an acceleration in the rate of deterioration. The problem had become so severe in recent years that the lintels had to be reinforced in order to prevent the collapse of this part of the temple.

Regarding surface treatments to retard weathering, reference has already been made to the use of linseed oil in paraffin. As this was applied indiscriminately over most of the Globigerina limestone megaliths in many of the prehistoric temples, it is not possible to evaluate the damage or otherwise of this measure. However, we find its effects dramatically illustrated in the case of two limestone heads found in the Gozo temples in 1827. These were taken indoors on being found and were kept on display or in storage up to the present day. At some point, probably during the 1960s, it was noticed that these objects were deteriorating rather rapidly (due to an accumulation of salts within them) and it was decided to treat them with linseed oil. Unfortunately, as well as darkening these originally pale yellow stone objects to a dark brown colour, this treatment resulted in the formation of a thin, partially consolidated surface layer which tended to fall off in large fragments, thereby accelerating the decay. Today the objects are very badly deteriorated and have lost many of their features.

Of all the works carried out at the temples the most controversial has been the moving indoors of the large carved blocks, which once formed part of the Tarxien Temples, and their replacement with copies, the earlier ones of stone and later ones of concrete. At the time of their removal this was the safest way known

to protect these most important examples of prehistoric art. That this was not a mistaken decision can be seen from the very good condition of these originals today, as compared with the stone copies which replaced them, and which are today badly deteriorated (Pl. 9). It can be argued that the stone out of which the copies were carved might have been of a poorer quality than that used for the originals, and this is quite possible. However, we have another situation where the originals were left in situ. This is in the Ggantija Temples where there were some blocks with spirals carved in relief, similar to those found in the Tarxien Temples. A set of watercolours painted shortly after the excavations of 1827 show these reliefs quite clearly. An account of these temples published in 1882 states that the spirals were still visible (Caruana 1882), while in another publication dated 1901 the author states that some of these carvings were too badly deteriorated to be accurately reproduced (Mayr 1901). Today, little indeed can be made out of these once beautiful decorations.

The present situation concerning the conservation of stone in the Maltese islands is happily much improved. The methods of restoration used in the past are being re-evaluated, and suitable alternatives sought, by the Stone Research and Conservation Laboratory recently set up within the Museums Department for this purpose. The problem of the weathering of Maltese limestones is also being studied scientifically, and appropriate conservation measures sought, with the aim of preserving these splendid examples of prehistoric architecture for future generations.

References

Ashby, T., Bradley, R.N., Peet, T.E. & Tagliaferro, N. 1913. Excavations in 1908-11 in various megalithic buildings in Malta and Gozo. Papers of the British School at Rome, **VI** (1), 1-126

B.R.E. (Building Research Establishment) 1958. The Maltese islands: use of limestone for building. Note no. B 188. Watford, Building Research Station

Caruana, A.A. 1882. Report on the Phoenician and Roman antiquities in the group of islands of Malta. Malta, Government Printing Office

Caruana, A.A. 1886. Recent further excavations of the megalithic antiquities of Hagiar-Kim executed in the year 1885. Malta, Government Printing Office

Evans, J.D. 1971. The prehistoric antiquities of the Maltese islands: a survey. University of London, The Athlone Press

M.A.R. (Museum Annual Report) 1916. Annual Report of the Valletta Museum 1916. Malta, Government Printing Office

M.A.R. (Museum Annual Report) 1937-38. Annual report on the working of the museum department during 1937-38. Malta, Government Printing Office

M.A.R. (Museum Annual Report) 1948-49. Annual report of the working of the museum department 1948-49. Malta, Government Printing Office

M.A.R. (Museum Annual Report) 1949-50. Annual report on the working of the museum department 1949-50. Malta, Government Printing Office

M.A.R. (Museum Annual Report) 1952-53. Annual report on the working of the museum department 1952-53. Malta, Government Printing Office

M.A.R. (Museum Annual Report) 1954-55. Annual report on the working of the museum department 1954-55. Malta, Government Printing Office

M.A.R. (Museum Annual Report) 1956-57. Report on the working of the museum department for the year 1956-57. Malta, Department of Information and Tourist Services

M.A.R. (Museum Annual Report) 1957-58. Report on the working of the museum department for the year 1957-58. Malta, Department of Information

M.A.R. (Museum Annual Report) 1958-59. Report on the working of the museum department for the year 1958-59. Malta, Department of Information

M.A.R. (Museum Annual Report) 1959-60. Report of the working of the museum department for the year 1959-60. Malta, Department of Information

Mayr, A. 1901. Die vorgeschichtlichen Denkmaler von Maltaa. Munich, Abhandlungen der k. bayer. Akademie der Wissenschaft, I Cl., XXI Bd., III Abth. (Shortened and revised version published in English under the title The prehistoric remains of Malta 1908)

Pedley, H.M., House, M.R. & Waugh, B. 1976. the geology of Malta and Gozo. Proc. Geologists' Ass., **87** (3)

Renfrew, C. 1972. Malta and the calibrated radiocarbon chronology. Antiquity, **46**, 141-5

Tampone, G. & Vannucci, S. 1987. The effects of modern restoration techniques on the prehistoric temples of the Maltese islands. ICOMOS (8th General Assembly and International Symposium 'Old Cultures in the New Worlds', Vol. I, Subthemes I and II, 484-489

Trump, D.H. 1972. Malta: an archaeological guide. London, Faber and Faber

Vannucci, S., Cassar, J. & Tampone, G. 1985. The treatment of a typical soft limestone with different consolidants: a comparative study. Bollettino Ingegnieri, **11**, 3-13

Zammit, T. 1916. The Hal-Tarxien neolithic temple Malta. Archaeologia, **LXVII**, 127-144

Zammit, T. 1927. The neolithic temples of Hal-Tarxien Malta: A short description of the monuments. 3rd. ed. Malta, Empire Press

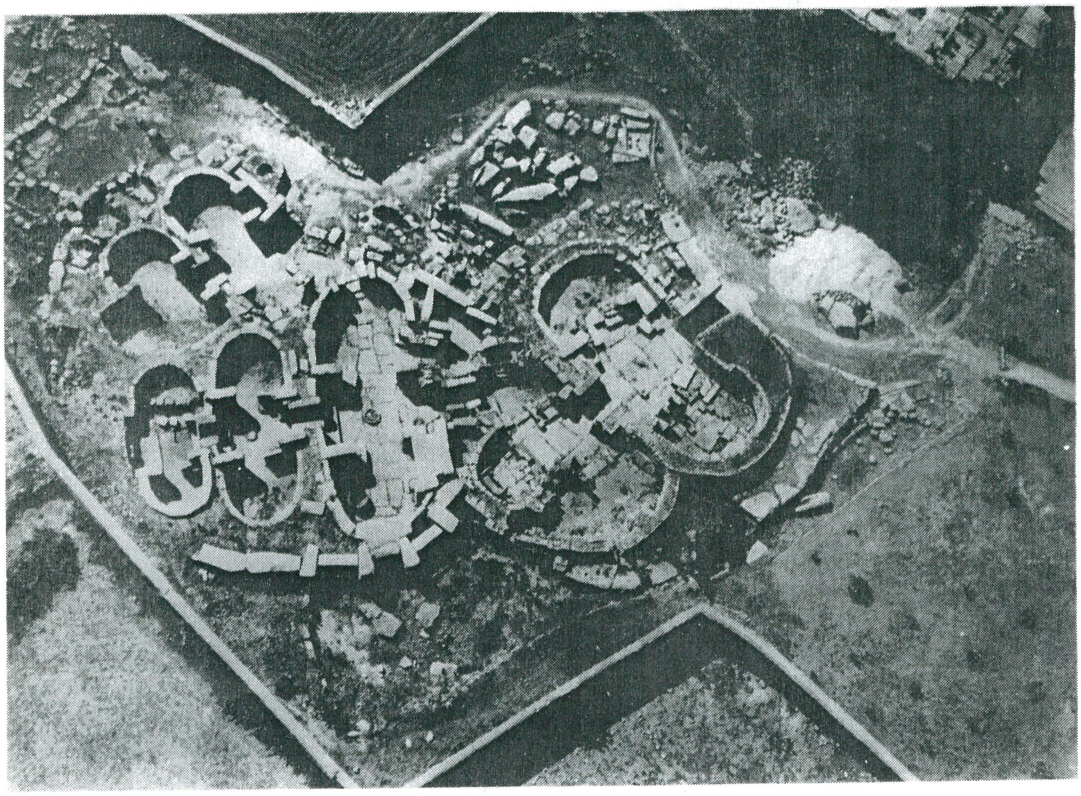

Plate 1 Aerial view of the Tarxien Temple Complex.

Plate 2 Horizontal block showing a deep crack throughout the entire length. Tarxien Temples.

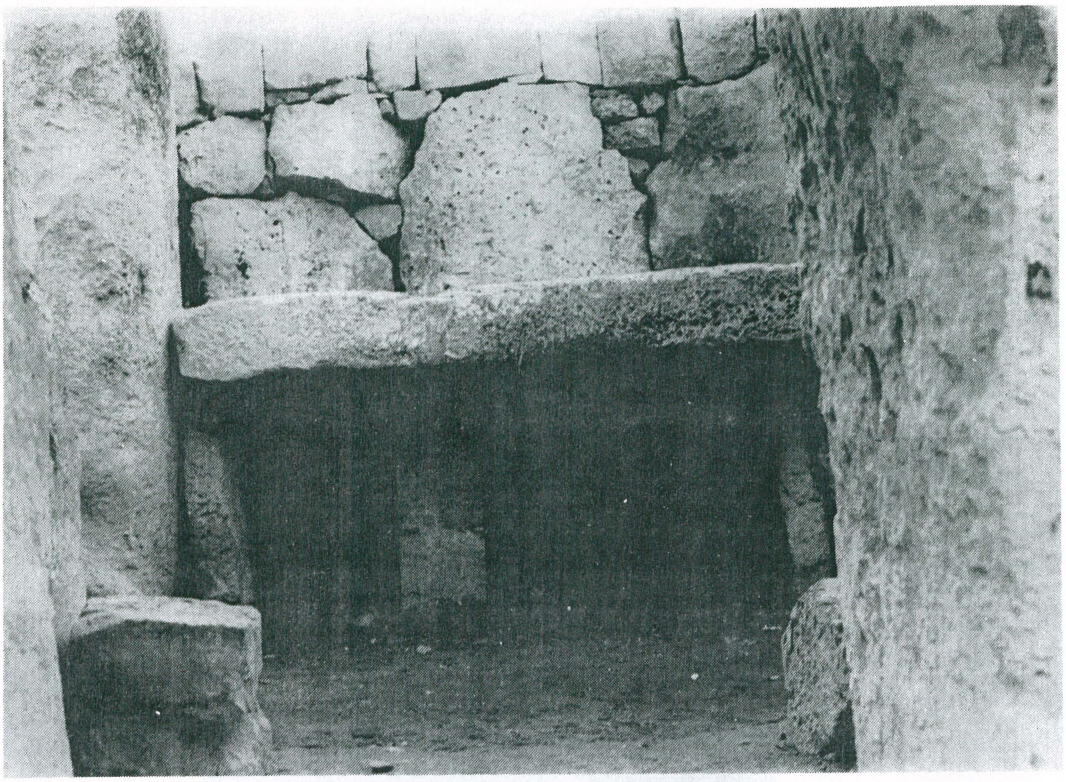

Plate 3 Modern pillar built of well-squared blocks, supporting a cracked table-altar. Mjajdra Temples.

Plate 4 Rusting iron dowels cause the formation of a series of new cracks in the block where they are embedded. Tarxien Temples.

Plate 5 Dove-tail joints holding together two parts of a broken megalith. Tarxien Temples.

Plate 6 Main doorway of the Tarxien Temple Complex, restored in concrete.

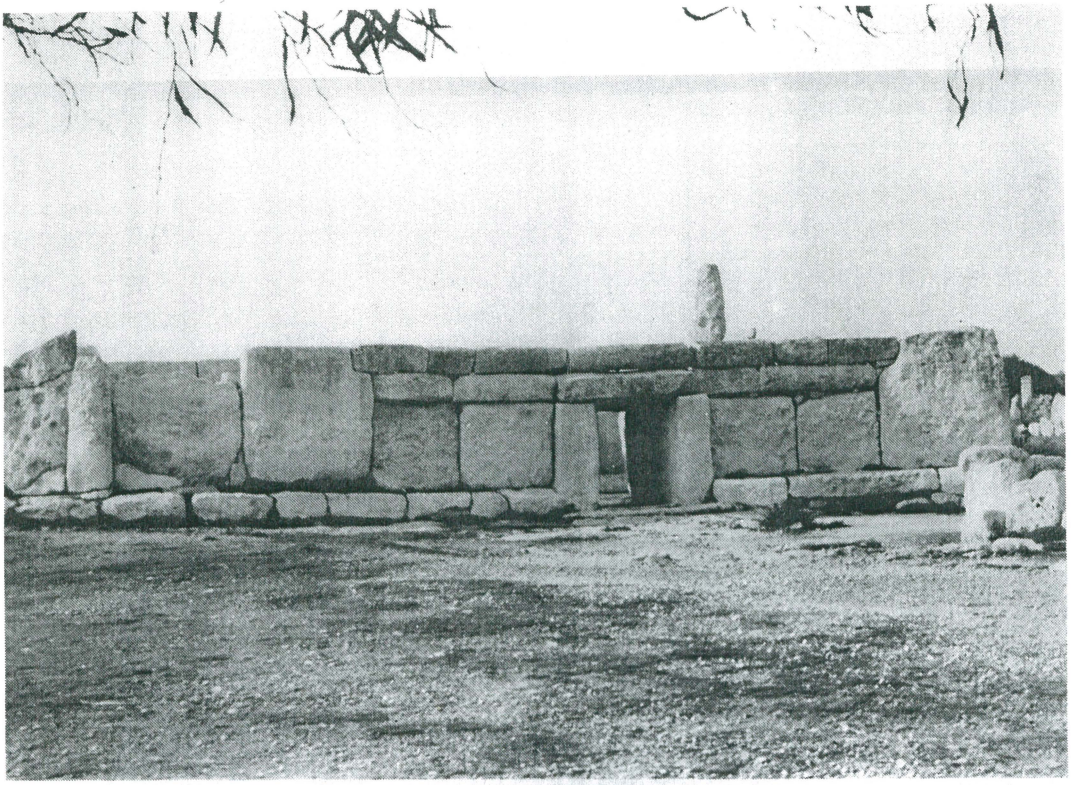

Plate 7 Facade of the Hagar Qim Temple Complex, reconstructed with the use of original blocks. Note also some of the original blocks which have been faced in concrete.

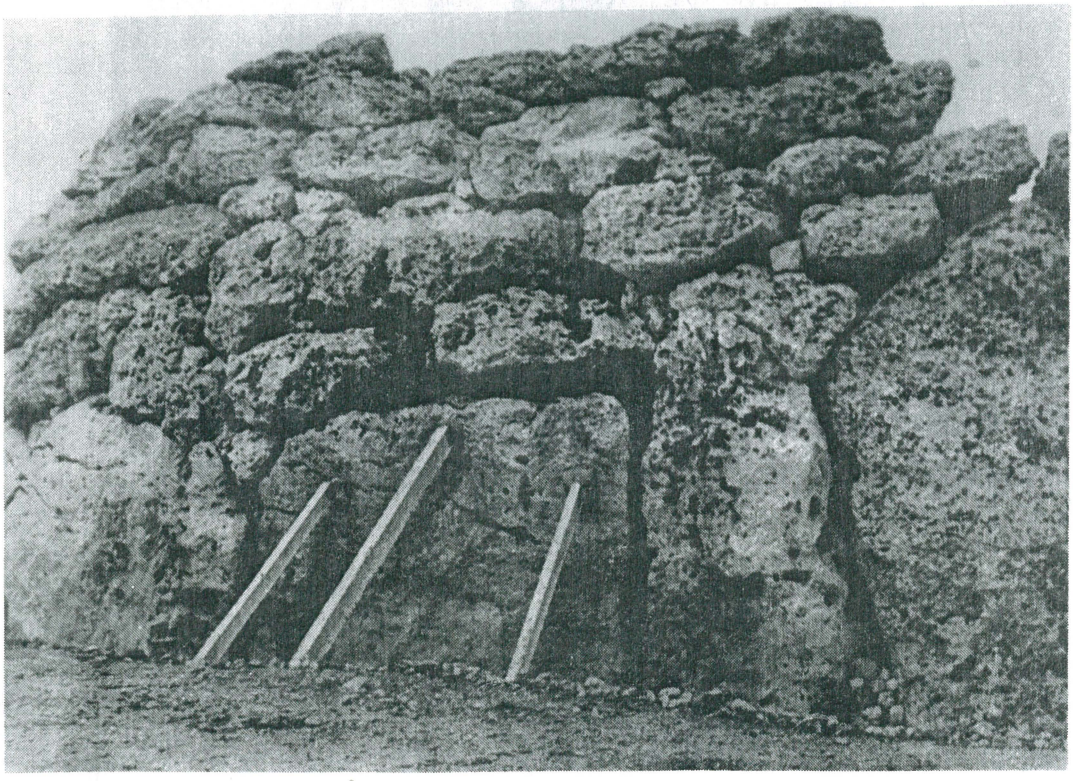

Plate 8 Steel joists propping up a megalith. Ggantija Temples, Gozo.

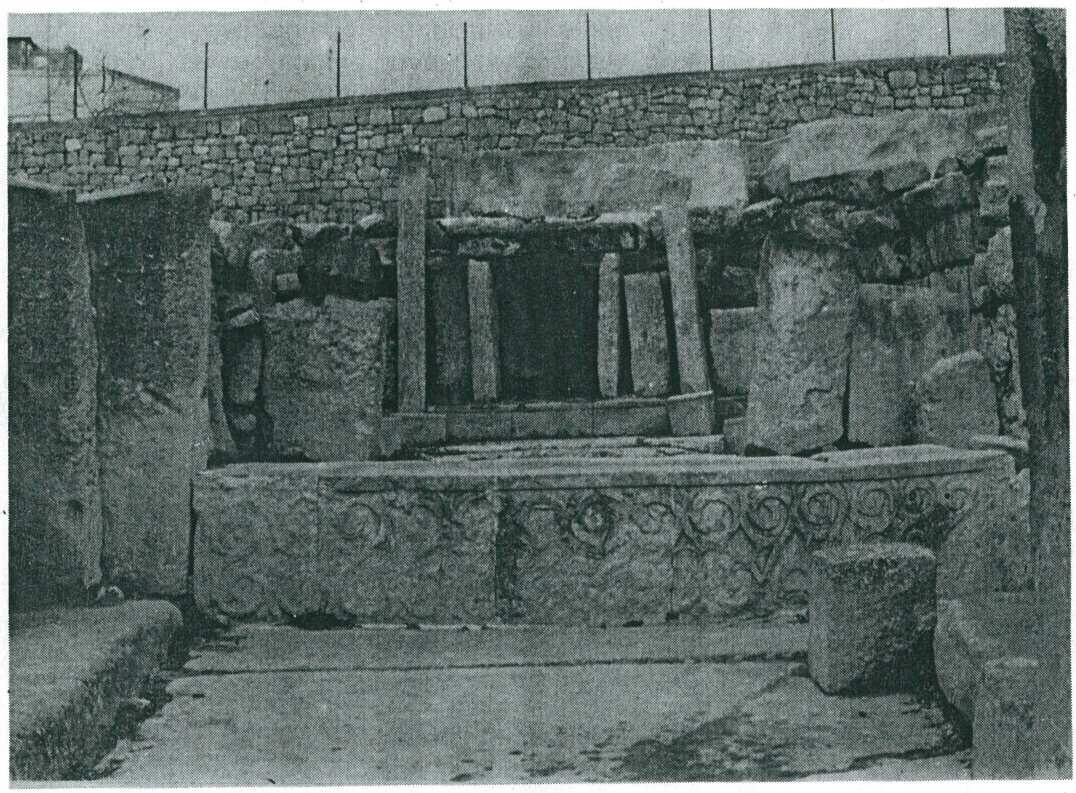

Plate 9 Badly weathered spirals forming the threshold slab in the middle temple of the Tarxien Temple Complex. This is a modern copy in Globigerina limestone.