

THE EFFECTS OF MODERN RESTORATION TECHNIQUES ON THE PREHISTORIC TEMPLES OF THE MALTESE ISLANDS

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In the hurried and superficial contemporary world, aware but insufficiently respectful as we are of ancient building techniques, the ease with which huge modern architectonic elements are moved and positioned can induce us to forget the hard work and care employed by the ancient builder of megalithic buildings for a correct rendering of their design. We also tend to underestimate his great accuracy of execution. The pre-historic megalithic temples of the Maltese Islands, included in UNESCO's list of monuments of world importance, are to be considered among the greatest examples of architecture and structural systems of all time.

The building of the temples was the result of the combined ingeniousness, skill, accuracy and hard work of entire communities. The ancient builders exploited the weight of the enormous monoliths and the mechanical properties of the stone, taking advantage of the reciprocal action arising out of the contrasting weight of the blocks leaning one against the other; a simple but reiterated system of hollows or embeddings and bosses was also adopted.

The temples are undergoing severe and irreversible degradation. The exposed surfaces thus manifest typical "corrosion" phenomena (at times in the form of true alveoli) caused by the dissolution of the calcium carbonate by meteoric waters which is enhanced by the salt-laden atmosphere, and also superficial disaggregation, together with the formation of crusts due to both thermal variations and the absorbed water. The prevalence of one or another of these mechanisms depends upon the structural characteristics of the stone, which vary according to its original stratigraphic level, the degree of exposure of the area, its vicinity to the sea, etc.

The most severe and rapid degradation of the temples began soon after their excavation, the Tarxien temple, discovered in 1914, being a notable and paradigmatic example. None of the temples still has its covering, so all the internal parts, including the decorative elements, are now completely devoid of protection. The ruins are, therefore, subject to devastating meteorological action: rainwater and atmospheric humidity, heat and cold, their effects on the blocks varying with their exposure, are wreaking havoc on the stone elements constituted of porous Globigerina Limestone and Coralline Limestone. No feasible project has yet been proposed for protecting the ruins without changing the appearance of what remains of the buildings and their settings. Our excessive trust in the problem solving capacities of modern technology can sometimes lead in restoration work to the ill-considered use of sophisticated techniques and new materials, such as synthetic products, which prove to be inadequate or even detrimental.

Restoration work has been carried out in an episodic manner on the Maltese

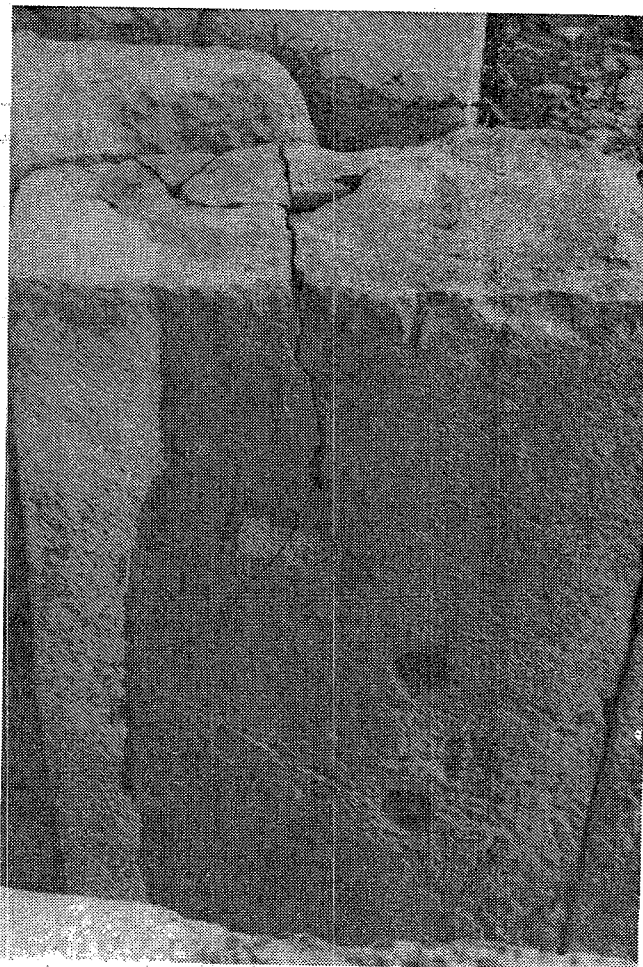
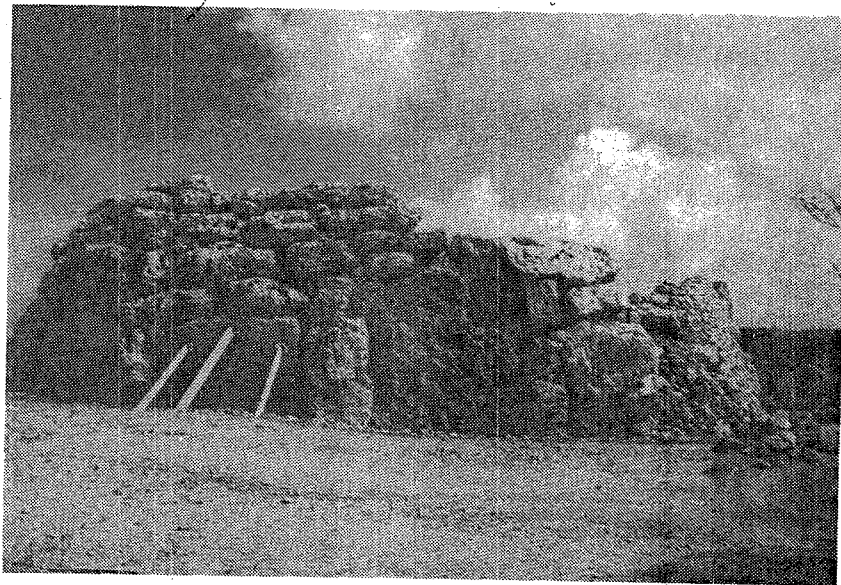
temples, generally with the intention of repairing, protecting or replacing parts of the buildings or of their single elements. Various techniques have been used, different ones sometimes being applied to the same problems. None of these interventions and none of the techniques have proved wholly satisfactory. However, they are of value today in that they constitute a catalogue and, to some extent, a paradigm of case studies in which both the restoration work and its effects are clearly legible.

Contemporary with the first excavations (Gigantija, 1827; Tarxien, 1915, etc.) the completion of ruined parts of the buildings, using small sized stones, was principally intended to prevent the buildings from collapsing; in this sense it proved to be efficacious.

The restored sections are clearly distinguishable from the original masonry. A good example of this type of work can be seen in the south external wall of the Gigantija complex; the new stones blend well in colour with the old.

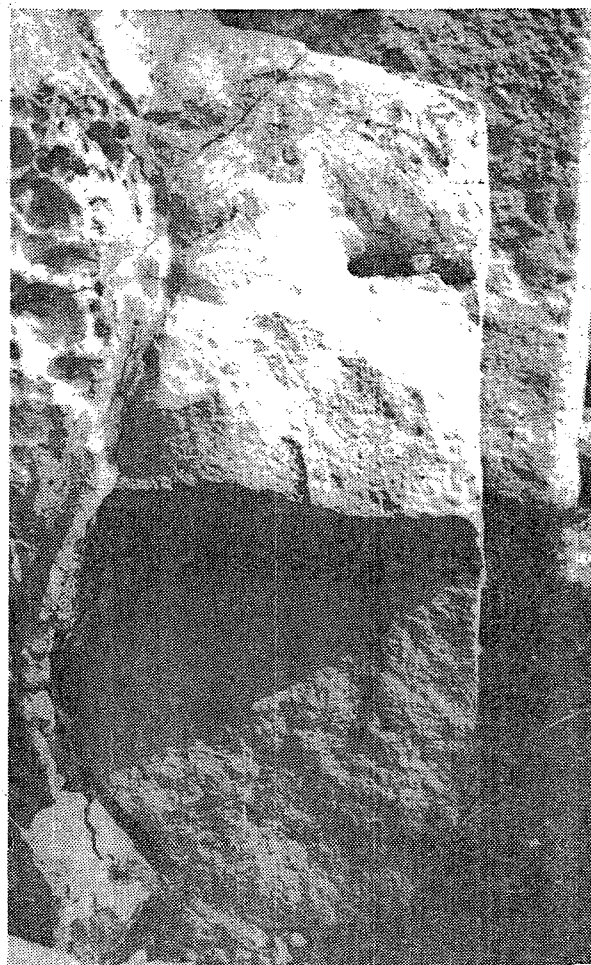
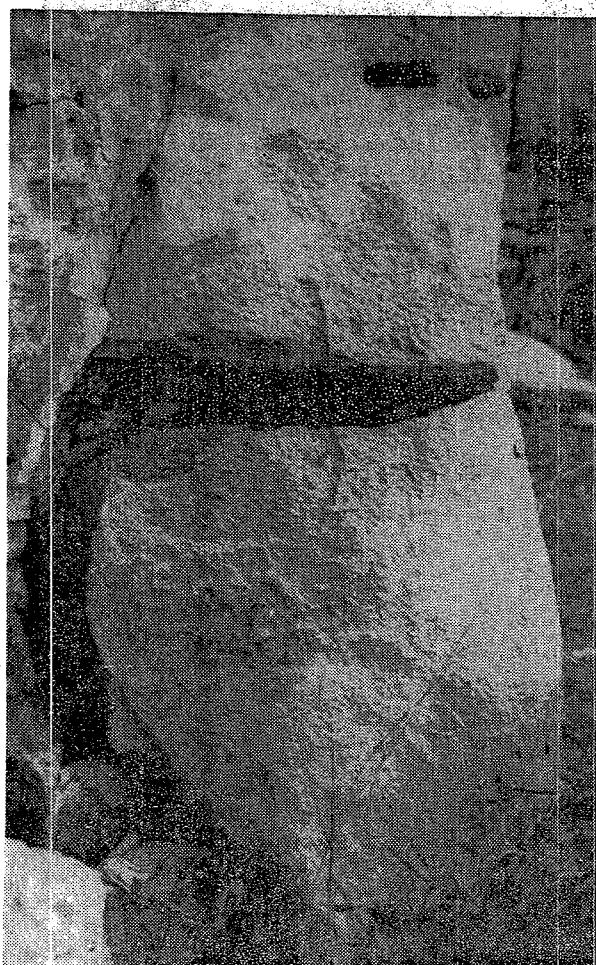
To prevent the rotation and collapse of one of the great slabs of the inferior order of the Gigantija temple, three inclined section irons have been put in place as permanent propping. One of these elements is now detached from the stone and is, therefore, no longer functional. The cause of this is to be found in a change in the movement of the slab due to the presence of the props and in the lack of a regulating device or, at least, of constant checking and maintenance.

A very few examples of the insertion of swallow-tailed stone elements to connect blocks affected by cracks, which can seem a natural practi-

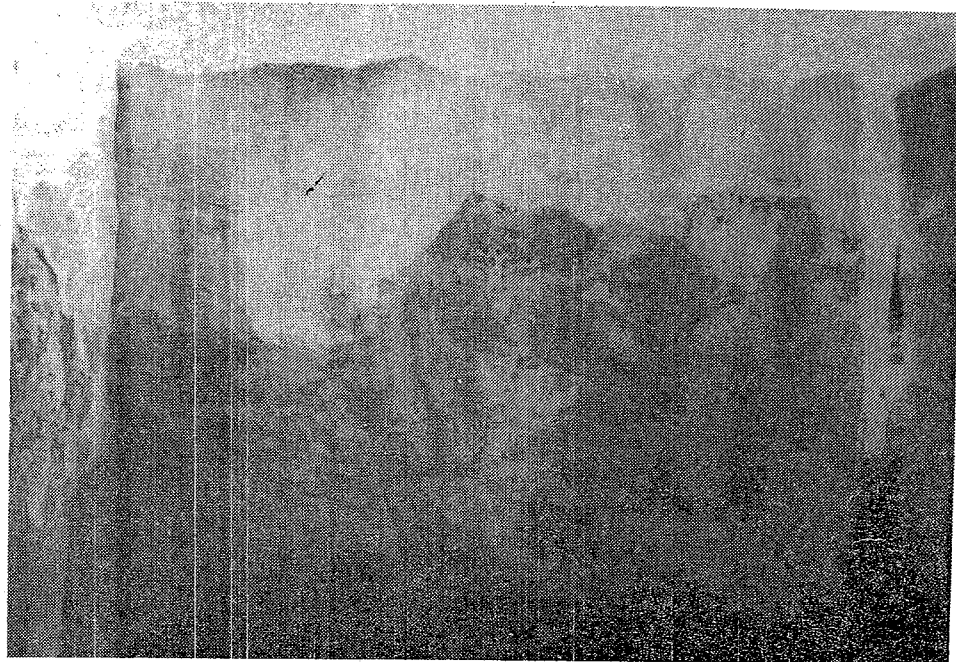


ce in the restoration of stone monuments, can be observed in the Tarxien temple. No records of them can be found but we may suppose that were done soon after excavation. In one case the device itself has broken owing to further movement and in another the crack later by-passed the device. In both cases, in fact, the cause of the cracks had not been removed.

Many of the soft Globigerina Limestone blocks are affected by splitting and by widespread cracks; the mechanical action (the weight of the upper masonry, concentration of pressure in small areas, etc.) must be taken into account as the principal cause of these degradations, but the influence of weather factors must also be acknowledged. The use of iron bars inserted in the broken blocks and sealed to the stone, a method widely adopted in the temples, especially those of Tarxien and Hagar Qim, has in many cases caused severe damage. The different thermal behaviour of the stone, of the concrete or resin sheath, of the metal and the products of corrosion, particularly where the exposure of the blocks renders them subject to a great temperature and humidity gradient, has caused a network of new cracks characterized by rupture surfaces orthogonal to the previous one and a radial disposition around the bar. The consequent penetration of humidity combined with the action of marine salts accounts for the rusting and corrosion of the bar, the increase in volume of the metal and its corrosion products, and a resulting acceleration of the whole complex process.



The most extensive repair work on the Maltese temples has been carried out with the ample funds provided by an American foundation. Caps of concrete (?) were put on the broken blocks in order both to prevent further degradation and, more importantly, to recover a partial image of the



construction. The Tarxien temples have been extensively submitted to this treatment which would be unthinkable today. A number of the problems which have to be faced today arise out of the great hardness of the concrete in comparison with the softness of the Globigerina Limestone. Furthermore, the free upper surfaces of the caps channel rainwater to flow down the vertical surfaces of the blocks. The huge block of Tarxien which carries the bas-relief of the sow and bulls is a dramatic example of the seriousness



of this problem.

The condition of the bas-relief, which is already difficult to decipher because of missing parts and of the rough and chimsy sealing of cracks with grey cement, is precarious, and if it continues in this same condition it is likely to be completely destroyed within a few years. The part which includes the bull and sow has become almost completely detached and is virtually a huge flake held to the substratum at a few limited points as has been verified with internal water percolation tests (see plate). The phenomenon of detachment is favoured by the fact that the blocks have been worked with their major surface parallel to the original stratification of the rock, but there is no doubt that the modelling of the bas-relief



did, in itself, cause some damage in this respect. The surface with the three figures is severely decayed by "corrosion", desaggregation and the flaking off of minute particles.

Anastylosis, one of the most accredited methods of restoration, was extensively applied to the ruined walls of the temples. In the absence of documentation, here the material evidence of shape, size, embedment and fit was followed in order to re-position the fallen elements where certain identification was possible. The results are, in general, correct. The Tarxien and Hagar Qim temples may be seen as good examples of a successful application of this method. However, there are some negative aspects which must be considered. The re-positioning of the fallen stone elements was not done everywhere with the same accuracy, and in too many cases small stone wedges were inserted between block and block to ensure stability; this proves that the original fit which the ancient builders used so much skill in achieving has been lost. This was inevitable given the slight movement affecting the blocks still in place in the walls, and to counteract it would have required a much more careful and painstaking execution.

The defective bond is certainly the cause of concentration of pressure in small areas and, therefore, also the cause of cracks in the underlying blo-

cks, as can be observed in Hagar Qim and Tarxien (see plate). We must, therefore, realize that the use of the most advanced techniques does not in itself produce good results. They cannot be successful where they are not in keeping with the techniques used in the original construction of the monument under restoration or where the possible future effects of such technical intervention are not taken into account.

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The prehistoric megalithic temples of the Maltese islands are the result of the combined ingeniousness, skill and hard work of whole communities. The builders made use of the reciprocal weight of the blocks leaning one against the other and of a system of emeddments and bosses. The temples are undergoing severe and rapid degradation which began soon after their excavation. Since none of them retains any covering they are subject to devastating meteorological action which is damaging the porous Globigerina and Coralline limestone of which they are built. There is as yet no feasible plan for their protection. Some episodic restoration work has been carried out on the temples but none of the interventions and none of the techniques used have been satisfactory, though they are useful today as case studies. The completion of ruined parts of some of the temples carried out at the time of their excavation and using small sized stones was intended to prevent their collapse and in this sense was successful. The sections thus restored are clearly distinguishable from the original masonry. Iron props were used to prevent the rotation and collapse of one of the great slabs of the inferior order of the Gigantija temple but one of these is now detached because of a change in movement caused by the props themselves and because of the lack of a regulating device or of regular checking and maintainance. Swallow-tailed stone elements were used to connect blocks affected by cracks in the Tarxien temple. In one case the device itself broke because of further movement; in another the crack by-passed the device. The cause of the cracks had not been removed. Splitting and cracks in the soft limestone blocks are caused in part by mechanical action and in part by weathering. The use of iron bars inserted and sealed in the blocks has often caused severe damage. The different thermal behaviour of the stone, the cement or resin sheath, the metal and the products of corrosion has caused a network of new cracks characterized by rupture surfaces orthogonal to the previous ones and radial cracks around the iron bar. Consequent penetration of humidity and marine salts caused corrosion of the bar and acceleration of the process of degradation. The extensive repair work funded by an American organization consisted of capping the damaged blocks with concrete. Rainwater runs off these rainproof caps to flow down the porous vertical surface which flakes off in thick crusts. The huge block of Tarxien with its sculpture of the sow and bulls has been badly damaged in this way and may not survive much longer. Anastylis has proved more successful but in some cases has not been carried out with sufficient care and stone wedges have had to be employed between the blocks to ensure stability. The defective bond caused the concentration of pressure in small areas and so provokes cracks in the underlying blocks. The use of modern techniques does not in itself ensure good results. Restoration techniques must be in keeping with the original construction methods and the possible future effects of such intervention must be taken into account.

EFFETS DES TECHNIQUES MODERNES DE RESTORATION SUR LES TEMPLES PREHISTORIQUES DES ILES MALTAISES.

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RESUME. Les temples mégalithiques préhistoriques des îles Maltaises sont le résultat à la fois de l'ingéniosité, de l'adresse et du dur travail de communautés entières. Les constructeurs mirent à profit les poids réciproques des blocs s'appuyant les uns sur les autres et utilisèrent un système d'adossement et de clefs de voûte. Les temples subissent une dégradation aussi importante que rapide, dégradation qui commença peu après que des fouilles les aient ramenés au jour et qui est causée par les facteurs météorologiques qui détériorent le Calcaire à Globigerina et le C. Corallin dont ils sont faits. Les temples ont fait l'objet de quelques travaux épisodiques de restauration, mais aucune de ces interventions ni des techniques employées n'ont donné de résultats satisfaisants, bien qu'elles soient à présent utiles comme sujets d'étude. L'achèvement de parties détruites de certains des temples, qui fut mené à l'époque de la découverte de ceux-ci et vit l'utilisation de pierres de petite taille, était destiné à empêcher leur effondrement, et dans ce sens fut couronné de succès. Les sections ainsi restaurées sont facilement reconnaissables dans l'ouvrage original. Des béquilles de fer furent utilisées pour empêcher la rotation et l'effondrement de l'une des grandes dalles de la partie inférieure du temple Ggantija, mais l'une de celles-ci est à présent détachée à cause d'une modification du mouvement provoquée par les béquilles mêmes, et aussi en raison de l'absence d'une réglementation précise, de contrôles et d'un entretien réguliers. Des éléments de pierre à queues d'hirondelles ont été utilisées pour relier entre eux des blocs de pierre du temple Tarxien qui présentaient des lézardes. Dans l'un des cas le dispositif lui-même se rompit en raison d'ultérieurs mouvements; dans un autre cas la lézarde contourna le dispositif. L'utilisation de barres de fer introduites et scellées dans les blocs cassés a souvent causé de graves dommages. La différence des réactions à la température de la pierre, du revêtement de béton ou de résine, du métal et des produits de la corrosion ont donné lieu à un réseau de nouvelles lézardes caractérisées par des surfaces de rupture orthogonales par rapport aux précédentes, et des lézardes radiales autour de la barre de fer. Une association américaine finança d'importants travaux de réfection, qui consistèrent à recouvrir d'une calotte de béton les blocs endommagés, mais les eaux de pluies s'écoulaient sur ces calottes imperméables pour ruisseler sur les surfaces verticales qui s'écaillaient par couches épaisses. C'est ainsi que le bloc orné de sculptures représentant une truie et des boeufs qui se trouve à Tarxien a été gravement endommagé, au point qu'il pourrait rapidement disparaître. L'anastylose a eu davantage de succès mais n'a pas été effectuée dans certain cas avec suffisamment de soin, et des cales de pierre ont dû être placées entre les blocs afin d'assurer leur stabilité. Cette fixation défectueuse a causé une concentration des pressions sur des zones limitées, provoquant ainsi des lézardes dans les blocs. L'utilisation de techniques modernes ne suffit pas à elle seule à garantir de bons résultats. Les techniques de restauration doivent être adaptées aux méthodes de construction originales et il faut tenir compte des possibles futurs effets des interventions.