The Conservation Challenges of Hot, Low and Cold, High Deserts. Central Asia and TransHimalaya

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Introduction.

(Thanks to ICOMOS Australia and the James Cook University, all those locally, nationally and internationally who have contributed to this event and specifically and personally to Dr. Susan McIntyre-Tamwoy, convener of this conference).

A reasonable place to start this conference is to attempt to define the scope of what "Conservation" and what "Extreme" means to this conservator.

Within the range of ICOMOS activity, Conservation is a very broad church. Every manner of material, every type of context in which such a material or composite use of materials may be found, in standing, archaeological, under-water, frozen, melted, urban, rural, inhabited and in use, abandoned, adaptively reused, the natural environment, the cultural landscape, the road and trade route the pilgrimage path and so on, facets of heritage are included within the scope of the activities of the ICOMOS specialist and scientific Committees.

Beyond the above list less tangible but just as important aspects of heritage must be taken into consideration. Tradition, ceremony, power places and objects, dance, music, story-telling, even such concepts as "outstanding universal value" and "spirit of place" demand and deserve consideration. Anything less than this will not meet the rigorous standards expected.

All of this list is then divided into categories of endangerment, disappeared, at risk, endangered by disasters both natural and manmade, political, conflict and so on. There are an enormous range of heritage conditions and somehow, somebody within the almost 10,000 strong membership of ICOMOS internationally has specific scientific or artistic or historical skill in the topic, or may simply passionate about it, for reasons often above and beyond our understanding.

In the past, the built and archaeological heritage environment was highlighted and favoured, but in more recent times more intangible factors have also gained greater understanding and stress.

If we take conflict as an example of extreme conditions, we discover how all pervasive the damage to heritage can become; natural disaster reflects similar outcomes.

In the Mahgreb on the fringes of the Sahara desert in North Africa the second world war changed everything there was and generally is, in all disaster scenarios. There is never a return to “normal” traditions or the old ways, something, often a great deal, is always lost and never returns; this may be described as progress or evolution, but for the conservator, it is simply “loss”.

In 1945, the Mhagreb region saw a return of malaria. An astute social anthropologist recognized that one traditional ritual amongst many that disappeared during and after the conflict was particularly significant where malaria was concerned.

Before the conflict there had been a ritual springtime dressing of wellheads with limewashes and ceremony; this had disappeared. In that time of year mosquito larvae hatch in the wellheads, often the only sources of water within the natural and social environment. The anthropologist recognized that the lost ceremony had the practical result of killing the larvae and thereby eliminating a huge part of the mosquito risk.
The well dressing tradition which exists in so many parts of the world including my own country, England, was re-established and from the following year and since, the problem of malaria is reduced or in some regions entirely eliminated.

Almost every cultural ritual, taboo or festival has some very practical result within the cultural community and health, in all its forms, is often the beneficiary.

The message is therefore reinforced, that cultural heritage and its conservation is a very broad church.

Your speaker is a technician, a geologist, architect, conservator and this is the foundation of two studies that this conference will, for a short time, consider. Beyond the technical aspects of this presentation, the speaker requires that all those involved in conservation and all its aspects, keep sight of the holistic picture which he has less than adequately tried to define. Only then can the practitioner truly make an effective and valuable impact within the conservation field that will be discussed and debated here in Cairns in the next two days.

The Low Western Kazakh Steppes and the ancient city of Otrar. Turkestan.

At the edge of the Kyzylkum desert in the barren part of the Central Asian steppes in Kazakhstan, flows a large but fragile river, the Syr Darya, one of two major Central Asian Rivers which drain into the changing Aral Sea. The Amu Darya, rising in the Pamir mountains, defining the northern border of Afghanistan crossing Turkmenia/ Semirechie and entering the Aral from the South and the Syr Darya, springing in the Lakes of northern Uzbekistan , snaking across the Southern Kazakh steppe and entering the Aral from the north, The Aral is a rapidly disappearing sea. In the last 20 years, the Syr Darya often dries up before it ever reaches the sea.

In mid flow, the Syr Darya meanders close to the ancient city of Otrar, A huge place with occupation evidence covering some 250 square Kilometers, seven principle Mounds, Tobes, representing the seven historic citadels established over the life of the City. Archaeological evidence suggests occupation since 2nd Century BC Zoroastrians foundation.

The city thrived in an important northern branch of the silk roads, made the more important by the north/south migration routes of the nomadic tribes of the steppes. Otrar then became the meeting place of cultural traditions and became an important center of trade, science and art especially during the 6th-12th Centuries.

In the mediaeval period Otrar suffered the military intentions of the various hordes and was besieged by Gengis Khan who defeated the city after an intense and dreadful year long campaign. The city was destroyed along with a fabled library and most of the inhabitants.

Timur Leng followed 100 years later, developing the city and its region. Neither Timur nor Gengis killed artists and craftsmen and so architecture and art continued to thrive. Timur died of influenza while staying in Otrar prior to his proposed invasion of China.

In the 1960s/70s, the nearby Aral Sea, started to dry up, simply because the Sir Darya River failed to complete its journey and dried up in the Steppe.

As the Aral dries up, the remains of human settlement once under the waves, show that periods of wet and dry have happened historically. Indeed, the whole Western Kazakh Steppe has in relatively relatively recent times been a huge shallow inland sea.

The region has for centuries changed from barren sea to a harsh desert which flowers in the winter rain and bitter temperatures brought by winds coming down from Siberia. Perfect land for nomadic grazing, difficult land for settled habitation.

During the Soviet Union period, brave attempts were made to support “green deserts”, in the Western Kazakh steppe, the principle crop was cotton. 1 meter and deeper pan busting caused the salt pan beneath the topsoil in this ancient sea, to break up, this generated heavy soluble salt mobilization in the region, wells started to become brackish and the landscape filled with windblown salt which leaves the local Loess clay soils holding 6-11% of soluble salts which have a disastrous effect on the delicate clay archaeology.

Soviet archaeology, in keeping with the times in which it was practiced made excellent study and documentation, but never considered it important to preserve the excavated structures and material. It was felt that the documentation was sufficient.

Changing metrological conditions.

In the last seventy years the climate has been quite regular with soft precipitation in the winter leading to the formation of shallow wetlands and active “wadis”, feeding into the rivers. Snow is rarely deep being windblown and light.
More recently the weather, especially precipitation patterns are changing. The rain, although not falling in much greater amounts, occurs in short violent downpours, often accompanied by strong winds and close to tornado like events.

The stronger and windswept rainfall has a profoundly damaging effects on the delicate loess clay archaeology occasionally eliminating structures, through mechanical erosion, in a matter of a few hours.

There is now a better understanding of the forces at work here and of the causes and projected prognoses of these changing patters now generally defined as “global climate change”.

At Otrar city, UNESCO, in partnership with the Government of Kazakhstan and Funded from the Japanese funds in trust. A programme was designed to explore conservation problems working in close association with Kazakh colleagues.

Geology and the nature of construction material.
The predominant soil type in the Central Asian Steppes is loess clay. The beds of the Central Asian loess clay belt stretch between Macedonia in the West to China in the East, from Siberia in the north to Baluchistan in the south, they are not constant, but appear and reappear throughout this region. The common name of loess is Aeolian clay, and as this name implies, it is produced by the action of wind erosion on igneous rock. This explains its range of particle sizes, towards the fine end of the normal soils index. Its main constituents are silt and clay, and its sand fraction is a very low percentage of the total mass. Gravel is not present at all, whilst the carbonates and salts content can be high when compared to other types of soils. Both the clays, the silts and the sands are of small size, and despite the expectation of those accustomed to water clays and silts, who are used to encountering a far larger range of particle sizes, it makes an excellent building material, and is used as such in many parts of Asia.

The majority of platforms, walls and structures are made of this unfired loess, commonly adobe blocks but occasionally from piled or monolithic construction. Fired bricks do appear in later high status structures.

Mechanisms of Decay.
The study and the documentation of decay is of vital importance for the conservation of earthen structures. If the condition report is carried out systematically, the same process can be repeated after a certain period and the results can be therefore compared. This can be extremely useful for evaluating the behaviour of wall structures in the long term. The main mechanisms of decay encountered in the structures of Otrar Tobe are the following:

Mechanical damage from rain

Earthen structures are mechanically eroded by the action of rain, but also by the lack of drainage systems which can create a system of preferential channels on the wall surface. This is often due to lack of capping or sheltering which can cause irreversible damage, and the washed out soil is collected at the base of the walls.

Fauna

Birds, rodents, and masonry bees are heavily eroding the earthen structures of the Tobe, and this is especially visible in the excavated section of the Great Wall where the local fauna tends to nest. Here decay is represented by a system of tunnels with varying diameter from one to ten centimeters.

Flora

Otrar Tobe is characterised by a substantial amount of flora which grows between the wall structures and rarely on top of walls, whilst the slopes of the hill are less affected by vegetation. The flora is represented by succulent plants, prickly desert grass, and a shallow rooted grass locally known as *shym*.

Man-made damage

The most urgent conservation action in Otrar was the fencing of some of the Later Mosque, of the Palace, and of the Great Walls. This was necessary to discourage visitors from walking on earthen walls and from causing further damage. It should also be noted that recently graffiti was observed on both earthen and fired brick structures.

Man-made damage is also present on several sections of the earthen walls facing the Palace where diagonal tool marks can be clearly interpreted as the product of previous archaeologists.

Man-made damage can be accelerated if earthen structures are not fenced properly. For instance, Altyn Tobe is frequently visited by local people who ride horses and donkeys on the earthen walls and this was observed by the authors during several site visits.

Coving effect

This is a typical decay symptom of earthen walls, especially when not supported by a stone plinth. It is the product of the combination of soluble salts rising from the ground which destabilises the build material, and of wind erosion. Salts can effloresce on the surface of the wall base and when this is accompanied by the combined action of wind and windblown sand, the area affected by efflorescence is easily eroded. When this is repeated several times, the section of the wall base can become thinner and eventually lose its load bearing capacity, causing collapse of the structure. Direct inspection of several structures of the loess clay belt show that the rate of decay is influenced by directional exposure to the prevailing wind and by the geography of the site itself.

Thermal expansion

Between an earth brick and an earth mortar of similar character, the problem of thermal expansion between different materials is unlikely to apply.

There is however the need to be aware of thermal expansion as a possible cause of cleavage planes developing between fired brick and mud mortars. It is of course the fired

brick which is likely to show a higher index of thermal activity than the mortar which surrounds it.
If a cleavage plane develops between these two materials, it should be noted that thermal expansion cannot be ruled out as a cause.

Differential salinity
The question of salinity is appropriate to be asked at Otrar Tobe. The region is and has historically been of high salinity, with soluble salts visibly effloresceing on the surfaces of both virgin geology, ploughed areas and on the archaeology.
The largest question, and one that cannot be answered by a field laboratory, is the effect of migration of salts between the historic materials and introduced conservation materials.
It has been noticed that when a virgin material from a remote source, and known to be of low soluble salt content is used in block form as a reinforcement member in the context of an historic wall, micro cracking and the appearance of a visible cleavage plane, is characterised by a slight trace of visible efflorescence at the interface between the two materials.
It is believed that this may be caused by soluble salt migration between the historic brick, and the virgin material, through the virgin mud plaster used at the interface. The historic brick becomes damaged at the immediate boundary of connection.
This is a strong reason to experiment with locally obtained virgin material, and material from spoil heaps on the Tobe, which has a similar soluble salt content as the historic material. The use of this material limits the activity of salt migration, and supplies a form of stability to conservation interventions.

Impact of regional variations from climate change.

Testing.
Most of the onsite testing is carried out using a more or less standard soil mechanics regime including:
Visual identification
Smelling test
Dry strength
Hand texture test
Lustre test
Adhesion test
Tap test
Sedimentation test
Cigar test
Ribbon test
Wet/dry colour
Efflorescence.

On site empirical testing is a vital tool in the assessment of historical and geological materials.

At Otrar a mobile soils testing Laboratory was assembled by Dr. Enrico Fodde and all empirical tests were confirmed using laboratory tools.

Selection of conservation and shelter-coat materials.

All materials, naturally occurring or man made, will behave within different parameters depending on their qualities within the range described above, and rather like the periodic table of elements, we can say that depending on these conditions, any material will sacrifice itself to other materials which may be described as harder, less porous, or more tangible than the sacrificing material.

Mud brick is an excellent example of a 'soft' material. It will sacrifice to any material of less porosity, greater 'strength 'a lower hydrophilic nature or indeed any hydrophobic qualities. For instance, if we repoint or cap a mud wall with a cementitious material, the mud brick will sacrifice or dissolve in favour of the repair medium. This occurs for a very simple reason. The mud brick will absorb more water than the cement medium, all the reactions of freezing, wetness, drying, efflorescence and so on will occur within the mud brick element. The same can be said for a wall of porous fired brick, when pointed or capped with cement, once again, all the water present in the environment will be led into the porous brick, which will sacrifice to the cement. Pointing and capping must always be achieved in a material 'softer', more porous and more hydrophilic than the original. Water reactions will then occur in the new interventionary material, and it is this material which will sacrifice for the protection of the historic elements.

Former generations understood this problem very well, but since the arrival of cement in the 19th century, the principals of construction have entirely changed. Where ancient structures managed and lived within the natural ambient environment through routines of regular maintenance, modern cementitious construction seeks to fight the natural environment, keep the water out. The two approaches to the materiality of construction are rarely compatible.

A phrase, and a useful one, has emerged to describe the ideal direction for the conservation of structures, Repairing,'like with like'. It is useful because it exactly describes the need to balance the sacrificiality of historic materials, and those used for conservation interventions. Like with like means using mud with mud, porous brick with porous brick, lime mortars with lime mortars and so on. This must be the safest course for the conservator. There is however a note of caution here. Even if the contents of an historic sample are reproduced as a conservation medium, the material may have bad performance characteristics. An ancient material may have suffered interstitial degradation and decline over years of weathering. Various mechanisms of decay, oxidisation, hydrolysis, efflorescence and so on may have occurred and an exactly reproduced material, but newly made, can still be 'harder' than the original. Analysis must be carried out, and this should be followed by field testing.

Since the nineteen fifties we have looked for modern and developing materials to provide 'magic' solutions to the problems of materiality. Concrete and cementitious products, soluble nylon and a whole range of organic polymers, silanes and the possibility of inorganic materials, but one by one these have showed weaknesses of performance and compatibility. Now we have returned to the sensible position of analysis and understanding of traditional materials and their application. We no longer arrogantly believe that modern materials can necessarily improve upon the traditional. Here at last

are evolving techniques which work, but not without a cost. Traditional methods are based on a high maintenance tradition, and we have become lazy and learned to look for low maintenance routes. It could now be said that high maintenance means long life, and that maintenance free means short life. This is not an unreasonable thesis. If we seek low maintenance solutions to conservation problems we run the risk of incompatibility, short life and poor results. What is required is a balance; our introduced materials must sacrifice, and at the same time, be as durable as possible, a fine science to perform.
In the world of restoration and reconstruction modern materials have found favour, often because construction companies who have no skill or expertise in conservation principles, aims or even science, carry out the work. It is regrettable that untold damage is probably being done to the heritage monuments of those places where these simple material facts are ignored or unknown.
Repairing 'like with like' therefore becomes a basic principle of the conservation of archaeological and architectural structures.

In Field activity and decision making.
At Otrar, once the historic materials had been understood in the context of the geological environment, the questions were simple to ask and difficult to administer.

Many square kilometers of excavation have been carried out during the soviet period, the archaeological record was good, but no conservation was used to protect the excavations from deterioration and eventual melting back into the natural landscape.
The project started by prioratising archaeological "windows", period, Location within accessible visitor paths, State of preservation, conserving a range of High and low status, industrial areas, social areas and so on.

Then a second and harder prioritization was made. Take no action, Backfill and conserve as open window or under shelter structures, temporary, (removed in summer) and permanent.

Kilometers of archaeology with advanced deterioration patterns, inaccessible places and so on, were left to melt in a natural pattern huge volumes of important archaeological places were backfilled with due scientific material selection and cautious and careful execution. These places are being occasionally monitored.

For the open windows structures were consolidated, cleaned up, protected from human and animal damage by walling and fencing, given well indicated visitor access routes and didactic interpretation.

The materials chosen to shelter historic survivals was carefully designed to sacrifice to the historic substrate, to be well separated and clearly indicated from the historic material and to fall into a regular maintenance programme for long term well-being.

"No maintenance" strategies are generally not satisfactory and yet it is realized that high and mid maintenance objectives, is a high risk strategy.

The project assessed that if temporary winter shelters were not replaced each year that backfilling was the only other solution available, and that if visitor numbers remain up, then Maintenance is affordable and more likely to continue since the closure of "windows" would limit the visitor experience. In time of low visitor numbers, then windows can be sheltered temporarily to prolong conservation life.

Mountain landscapes and high deserts.

A similar set of problems now beset the whole of the Himalayan plateau. Here the mountains are young and many of the foothills are made of loosely bound clay stones and shales. The causes of decay are much the same as the Central Asian experience. Changes in patterns of rainfall supply much harder and more violent rain and wind events, and once again these cause mechanical damage. Unlike Central Asia, there is little problem of soluble salt movement but this is replaced by other problems. The violent rainstorms not only do damage to ancient architectural structures but and perhaps more dangerously cause accelerated erosion of the hills upon which the structures are built. A further complicated issue of seismic activity adds to the challenges.

The structures have some traditional systems to resist the changing rainfall patterns through traditions of external painting and sometimes rendering, or, for instance, storing fuel sticks and wood on the roofs of buildings, cutting down the mechanical damage from hard rainfall and protecting the flat mud roofs. Construction techniques also reflect a sophisticated understanding of protection from natural calamity. In the mountains continues a tradition of rammed earth construction, rammed into wooden shuttering. Between the rammed lifts are ring beam "Mattresses" of sticks and vegetation which allow flexibility during seismic events with the mattresses acting as crack inhibition courses generally allow quite effective protection from tremours and go a long way to preventing collapse during seismic events. The regular mattresses, always horizontal in the wall also disrupt the formation of preferential water flow channels, which during formation and rainfall channeling invite crack formation.

At Basgo in Ladakh, in the Indian state of Jammu and Kashmir, World monument fund were sufficiently concerned about geological deterioration to construct a stone retaining wall which completely surrounds the temple hill.

Once hills are stabilized and walls appropriately underpinned, where necessary, then huge cracks developed by hinging and lack of foundation, require to be stitched and consolidated.

When stitching such a wall the conservator needs to recognize the protocol and function of sophisticated historic techniques employed to mitigate the construction problems which obtain within the perhaps hostile and certainly extreme local environment.and in the case of Basgo, this principally involves an understanding of a flexible mattress type of ring beam.

In Basgo monastery an attempt had already been made at stitching using long and flatstones. During seismic shocks, these stones can easily fall out from the wall, crack, set up cleavage planes and increase the risk of structural failure and collapse.

Originally wall in Basgo were constructed and rammed in short lifts of approximately 15 cm.each. In every third lift a vegetable 'mattress' was rammed in to the construction, the mattress being formed of a tough Heather type vegetation called Yagtsa. Here cracks were stitched in the same ancient techniques examined by the author across Asia and these were confirmed to have been described in cultural records by both Ladakhi and other sources. A Himalayan architect kindly made a drawing of the techniques used.

A chase is cut to almost half the thickness of the wall; this chase has deep returning ends in the form of a staple. The chase is continually wetted down with water during the construction process to eliminate suction leading to hairline cracks around the repair. The chase is then filled with alternative lifts of wet vegetation or woven matting with lifts of adobe bricks. The top course of the stitch some 10-15 Cms. deep is then wetted down and strongly but carefully mallet dry packed with loose material identical to that of the blocks. The dry packing presses down the whole stitch into a dense and strongly rammed fill. Alternate lifts are achieved at approximately half meter intervals, internally and externally. The stitches are of varying length to allow for stitching of subsidiary cracks and to prevent the formation of new cleavage planes that may develop from regular length stitches.
Internal walls can be reinforced with triangular stitches where cracks occur.

The author has added to the range of stitch forms by the invention of a capping stitch, made using the same techniques as other soft stitches, but of butterfly shape and rammed directly from above. This 'butterfly cap stitch' can then be covered by a domed shelter coat, generally used by the author to protect historic structures from weathering erosion and decay. While the soft stitches need little maintenance, situated as they are within the body of the wall and having similar compaction to the rest of the surrounding masonry, the topmost shelter coat requires regular maintenance.

This 'soft stitching' physically flexible technique is recognised throughout the seismic regions of Asia, and empirically understood by masons who frequently describe examples in their own region. Many subsidiary craft skills have been described to the Author including admixtures to the earth used for block repairs. Traditional techniques are now returning to this small part of the Himalayan Plateau, elsewhere they are forgotten.

<u>Conclusion.</u>

In extreme environments, conservation <u>decisions</u> have to be pragmatic, even harsh, while at the same time conservation <u>measures</u> have to be flexible and able to respond to changing conditions. Training of local people and scientists remains a vital element of action.

While the environment both geological and metrological may be almost impossible to predict, the conservator has to be very sure of both materials compatibility and suitability, but also to have a deep understanding of the traditional construction methods together with cultural use in the region of any site. Conservation in extreme conditions is not a free lunch, maintenance must be sustained.

Only by combining the lessons learned from these factors can the conservator make good decisions about methodologies for the protection and wellbeing of ancient monuments and historic traditions in the long term.

The more extreme the conditions, the more the conservator needs to hold an holistic appreciation of the conditions, physical and cultural which inform appropriate action.

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