"There were several reasons why we began our Theban survey in the Valley of the Kings and not elsewhere in the necropolis. The rapid increase in mass tourism that had begun in the late 1970s seemed likely to continue. It was especially heavy in KV, and careful planning would be required to keep the tourist threat to a minimum. Nonetheless, tourism and archaeological preservation are not necessarily antagonistic, so long as tourism is properly controlled."

Kent Weeks, 1998

Eighteen KV tombs are suitable for opening to the public (Table 53), usually 11 at a time on a rotating schedule. The other 44 tombs in the Valley are closed to visitors, some because of the need to protect them, some because they have not been cleared, some because they are undergoing restoration, some because they are of no interest except to specialists. Therefore, the condition surveys undertaken by the TMP have focused on this pool of tombs.

KV 1	Rameses VII
KV 2	Rameses IV
KV 6	Rameses IX
KV 8	Merenptah
KV 9	Rameses VI
KV 11	Rameses III
KV 14	Twosret/Setnakht
KV 15	Seti II
KV 16	Rameses I
KV 17	Seti I
KV 19	Mentuherkhepeshef
KV 34	Thutmes III
KV 35	Amenhetep II
KV 43	Thutmes IV
KV 47	Siptah
KV 57	Horemhab
KV 62	Tutankhamun
WV 23	Ay

Table 53: KV Tombs Accessible to Tourists

5.1 Previous Work by the TMP

People have been digging in the Valley of the Kings since antiquity, and the chronicles of their work are told in some detail in Nicholas Reeves and Richard Wilkinson's book, *The Complete Valley of the Kings*. However, the history of conservation work, touristic development, and recent archaeology in KV has yet to be written. At the present time, there are six missions working in the Valley: the Japanese in the tomb of Amenhetep III; the French in the tomb of Rameses II; the Swiss in the various habitation sites dotting the East Valley; the Americans in the tomb of Amenmeses; the British in the area between KV 9 and KV 57; and the Theban Mapping Project in KV 5 and around the Valley generally (Appendix V).

Figure 49: Surveying in KV 5

The Theban Mapping Project (TMP) was established in 1979 to prepare a detailed archaeological map and database of the Theban Necropolis. Its goal is to establish an historical and contemporary record of all the monuments in this 10km² World Heritage Site, beginning with the Valley of the Kings. It firmly believes that, if these ancient remains are to be preserved, the first and most essential step is to make detailed studies that record every archaeological, geological, and ethnographic feature at Thebes and regularly monitor the condition of its monuments. To date, the TMP has achieved the following goals:

It has compiled copies of all known maps, published and unpublished, of the Valley of the Kings. Together, these maps document the Valley's changing topography over the past 250 years.

It has compiled an archive of historical photographs and engravings from the late 18th Century onward that document changes in the Valley's appearance and track the history of touristic developments (such as footpaths and retaining walls) and the patterns of previous flash floods.

It has acquired aerial photographs of the Valley. The earliest dates from 1918, but the most important are the 1949 survey made by the RAF, the 1969 survey of the French CNRS, the 1980 photographic survey made for the TMP by Egypt's Academy of Scientific Research, a 1986 Egyptian Air Force survey, and the 1992 survey made for Waseda University. In addition, we are in the process of commissioning new satellite imagery of the West Bank to update imagery acquired by the Center of Documentation in 2003. The TMP has also made extensive use of hot air balloons to obtain oblique colour photographs of all the significant features on the West Bank.

It has collected existing topographic maps of the area and has prepared its own topographic map of the Valley of the Kings. The TMP map was published, together with detailed plans, sections, and axonometric drawings of all accessible KV tombs, in its *Atlas of the Valley of the Kings* (2000, reprinted, 2002, new edition, 2003, reprinted 2005).

It has conducted extensive geological, hydrological and structural surveys of the Valley of the Kings, and these reports have been published in its *KV 5: A Preliminary Report on the Excavation of the Tomb of the Sons of Rameses II in the Valley of the Kings* (2000, reprinted, 2002, revised edition, 2005).

It has developed plans for the protection of tombs in case of future flash flooding and rainfall (published in the KV 5 volume).

It has designed and installed interpretive signs for visitors to the valley: general maps of the valley, signs indicating which tombs are open to the public and detailed signs specific to individual tombs, describing their most important features, illustrated with photos and tomb plans. The signs are laser-printed on aluminium sheets to withstand the harsh environment of the Valley.

It has published an Arabic-language booklet on the Valley of the Kings intended for Arabic students who visit the Valley as part of their school history courses. An initial printing of 5,000 copies has sold out and is being reprinted by the Supreme Council of Antiquities.

It has made several KV tombs wheelchair-accessible by constructing ramps over sills in chamber doorways. Wheelchair-accessible tombs are identified on TMP signs.

It relocated KV 5, the tomb of the sons of Rameses II, and has devoted over 10 years to its clearing and preservation. It discovered that the tomb was the largest ever dug in the Valley of the Kings and one of the largest ever-found in Egypt. It was published in the KV 5 Preliminary Report (cited above) and updates appear regularly on the TMP's website. The discovery made headlines around the world and appeared on the cover of *Time Magazine* in 1995.

It has developed a website, www.thebanmappingproject.com, on which it publishes all the information it has assembled, including detailed maps, plans, photographs, and descriptions of all KV tombs, articles on Valley-related subjects, and zoomable aerial photographs of the entire Theban Necropolis. The site, which receives over six million hits each month, is the recipient of over a hundred awards for excellence in content and design, and has been chosen as a website of the year by the *New York Times*, the *Times* of London, the *Guardian*, the *Christian Science Monitor*, *Popular Science*, and many other publications.

> "The protection of our archaeological heritage must be based upon the fullest possible knowledge of its nature and extent. General surveys of archaeological resources are essential working tools in developing strategies for site protection. Consequently, archaeological survey should be a basic obligation in the protection and management of the archaeological heritage."
>
> Unesco, *Culture, Tourism & Development* 1996

5.2 Current Tomb Condition Report[4]

Figure 50: Dina Bakhoum, Conservator

In 2004-5, documentation surveys of accessible KV tombs were undertaken by means of a detailed photographic and condition assessment review. These activities serve several purposes. The photographs taken by the TMP throughout the years form a valuable historical database of the tombs and provide a detailed record of their condition. Historical images are being collected to provide even more historical depth to these records, and we propose that the tombs be photographed periodically (e.g. every 10 years) in order to monitor changes in a tomb's condition. It is important to note that this condition survey has been carried out visually. Only in KV 9 have monitoring devices been installed (more below), although such devices will eventually be installed in all open tombs, as funding permits.

The completed condition reports (Appendix III) deal with each tomb individually. In some tomb condition reports, each type of damage was given a symbol that is shown in a table below (Figure 53). The following example is from Corridor C in KV 15 (Figure 51 and 52), showing the left and

[4] Condition reports compiled by Dina Bakhoum, Lamia el-Hadidy, and Lotfy Khaled, see Appendix 3.

the right walls and the pictures taken of them. (Other detailed photos were taken but are not indicated on the general layout.)

The level of detail in the documented condition is enough to provide knowledge of the problems in a tomb, and forms an important record and survey of the tombs. On the other hand, it is important to note that before any restoration work is to take place, a more detailed survey should be carried out. The photographs taken by the TMP are useful in comparing the condition of tomb painting before and after restoration.

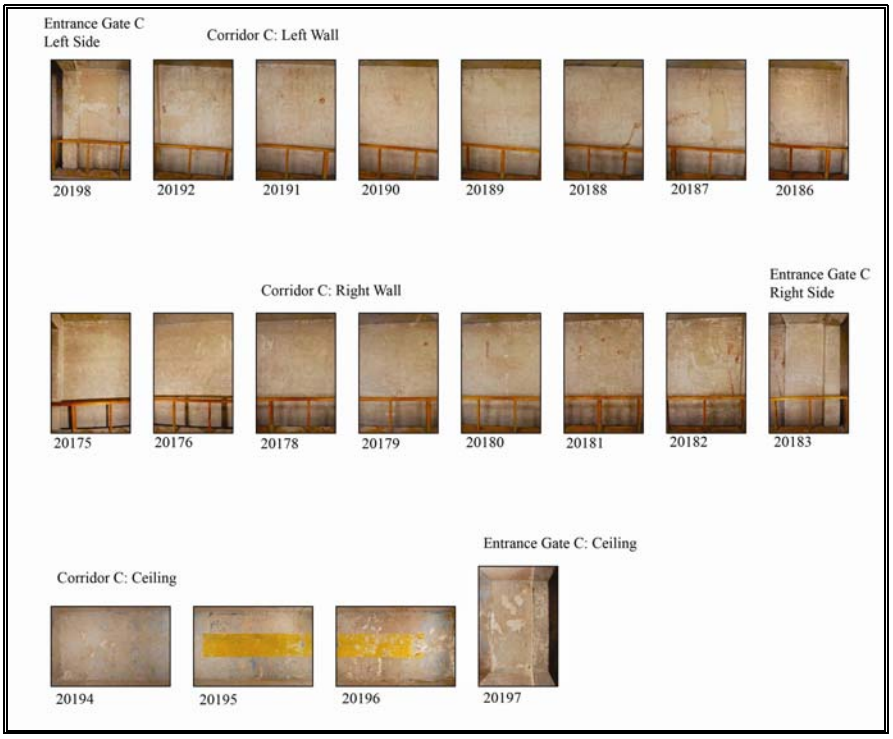

Figure 51: KV 15 Survey Photographs

Figure 52: Detail of KV 15 Survey Photograph

5.2.1 Methodology

The survey was conducted and laid out according to conventions adopted by international conservation bodies.

The structural condition

Most of the tombs in the Valley of the Kings are in a structurally stable condition. Cracks and fissures observed in the bedrock do not represent a danger to most tombs. In some cases, the cracks often

resulted in the loss of plaster layer. The loss of plaster in such parts must have taken place shortly after the tomb was decorated. During recent restoration activities, re-plastering took place in the tombs when plaster has fallen (due to its lack of cohesion to the substrate, see the condition of the plaster layer). Such re-plastering serves to protect the remaining plaster from falling. A major disadvantage of much modern re-plastering is that it hides the real cause of the deterioration.

The plaster layers

Ancient Egyptian tombs show different techniques of decoration. In some cases, the decoration was carved or drawn on plaster, in other cases it was carved in bedrock. If the tomb were to be plastered, then, after cutting the tomb, a plaster layer would be applied, then scenes drawn in red lines (often later corrected in black ones). The plaster was then carved and painted. When reliefs were to be carved in stone, a very thin plaster layer was applied, and then the same procedure of drawing first in red lines, then correcting in black, then carving was followed. The choice of the technique might be related to the dynasty when the tomb was cut, and also depended in some cases on the quality of the bedrock.

In tombs that were plastered, the plaster was usually applied in two or more layers, a thick layer as the main base, and another, thinner layer as the base for the colours. When the bedrock was uneven, it was often necessary to apply two thick layers of plaster. The material used for mortar was in some cases clay with straw, ashes, or, in other cases, gypsum or lime. The types of damage and deterioration observed on the plaster layer and/or the carved stone surface include the following:

- **a.** The loss of the thick and thin plaster layers; the bedrock is visible, but in many cases recent restoration has re-plastered over the lost areas (further discussion below in "Interventions")
- **b.** The loss of the thin plaster layer, while the background layer is still visible
- **c.** Powdering of the plaster layer
- **d.** Decay of the plaster
- **e.** Cracks or micro-cracks in the plaster layer or the bedrock. Often these cracks are related to cracks in the bedrock behind the plaster. In some cases, they are caused by the natural shrinkage of the plaster; in other cases, they are due to the detachment of the plaster layer from the substrate bedrock
- **f.** Detachment of the plaster layer from the background surface. This type of damage is very serious and can cause the plaster to fall away. In order to record this type of damage, one raps gently on the plaster and, according to the sound, one can identify hollow areas in the background. Detachment of plaster is also often indicated by micro-cracks, and in many

areas where numerous cracks were found it could be assumed that the plaster is detaching. Many such areas had already been injected during previous restoration activities.

g. Human-made damage: Scratches or hacking. In many tombs, scratches damaged the decoration and removed a substantial part of the plaster layer. Much of this damage can be attributed to ancient visitors

h. Human-made damage: Graffiti. Another form of human intervention is graffiti. This exists in numerous tombs in various forms over several centuries. In some cases, the graffiti are painted, drawn, or written on the plaster or stone surface. In others, they are carved in the plaster or stone. Numerous graffiti are the work of early travellers to the valley and give their names, the place they come from, and the date of their visit. In tombs where Christian monks lived, crosses and symbols were drawn on the walls. Beside ancient graffiti which has historical value, there is also some modern graffiti done by visitors during the last century

i. Wasp nests. Wasps built their nests on the walls and ceilings of many tombs. The problem with such nests is that they appear on the surface of the painting and cannot be easily removed

The paint layer and the surface

The paint layer is the final layer applied to the surface of the plaster. Its deterioration, flaking, and detachment depend on the type of pigment, the binding material, and the grain size. The main types of damage are the following:

a. Loss of the paint layer. In numerous tombs, paint was lost mainly in the upper parts of walls and in the corners of ceilings. This is perhaps due to the higher humidity in those areas

b. Flaking and detachment of the paint layer

c. Chromatic alterations, such as the fading of the colours

d. Abrasion of the paint layer

Some damage, although not directly related to the paint layer, is found on its surface and is therefore included here.

e. Soot blackening. In many tombs, the upper corners and upper parts of walls in corridors and chambers show blackening on the surface. In historical photographs, the black appears to be more intense than today. This black soot is most probably due to fires used in antiquity to provide light and heat. Much of this soot has been cleaned during recent restoration activities, but it has not been completely removed. For example in corridor D of KV 6, the soot has not been removed and looks today as it does in the historical images. In

some recent restoration interventions, paint was applied over the black soot in order to hide it

f. Blackening due to humans touching. People tend to touch areas where special scenes are indicated, and corners of gates or pillars while going up or down a corridor. This constant touching blackens tomb walls and, in some cases, fragile parts of the paint or the plaster have been knocked off

g. Dust accumulation. On almost all walls in the tombs, dust is accumulating and causing colours to appear darker and less intense than they really are. As there is no regular maintenance of the tombs and the dust is not regularly removed, it accumulates, sticking to the paint due to the high humidity in the tombs. This is very damaging, as it becomes heavy and causes underlying painting to detach. This phenomenon appears on almost all of the walls. It was therefore not marked on each photograph but indicated only where the conditions were especially bad

h. Incrustations on blue and green pigments. A strange black incrustation appears on much of the blue and green pigments. It does not appear on any other colours. More analysis should be carried out to understand why it appears here. Perhaps it is the result of a chemical reaction with certain consolidants

i. Salt efflorescence

Interventions

Walls were thoroughly checked not only for damage but for any modern intervention; although some interventions clearly prevented the tomb's decoration from being lost, others resulted in serious problems.

a. Re-plastering of missing parts. Modern plaster has been applied to almost all lacunae

b. Stains due to chemicals used for injections and consolidation. In numerous areas of the ceiling and the walls, injections were used to strengthen detached plaster or paint to the substrate surface. The holes used for such injections are still visible, and show staining around them. In some cases, a kind of blackening or yellowing appears in areas at the centre of the wall. It is not due to dust accumulation, fire, or bats. Due to its odd location, and the way it affects pigments, it is assumed that it is due to certain chemical consolidants that reacted badly with the background materials. Samples of plaster in such areas should be analyzed to learn what materials were applied there. In other areas, there are incrustations, blackening or chromatic alterations that might be due to the application of chemicals. It was also noted that the injections were not done carefully enough to avoid leakage lines and stains

c. Paint over black soot

d. Retouching. In some tombs, there was retouching of areas where the plaster has fallen. Modern plaster was applied, then re-touched

e. Wooden inserts for electricity cables. In some tombs, rounded wooden inserts were found at intervals in the upper part of the wall. In KV 6 these inserts still carry the old electrical cables used for the lighting of the tomb

f. Glass panels. Glass panels have been installed in many tombs to protect the paintings from touching, scratching, or other damage. For this purpose, the glass panels are very effective. For example, in some tombs the plaster and paint layers are very fragile, about to be detached if touched. But, despite the advantages of the glass panels, they do also have serious disadvantages that can result in worse deterioration of paintings. These panels are not fixed, as for museum objects where the environment is completely controlled. The glass does not reach the ceiling and accordingly the dust gets in and remains on the walls. The heat and humidity accumulated behind the glass are also dangerous to the painting.

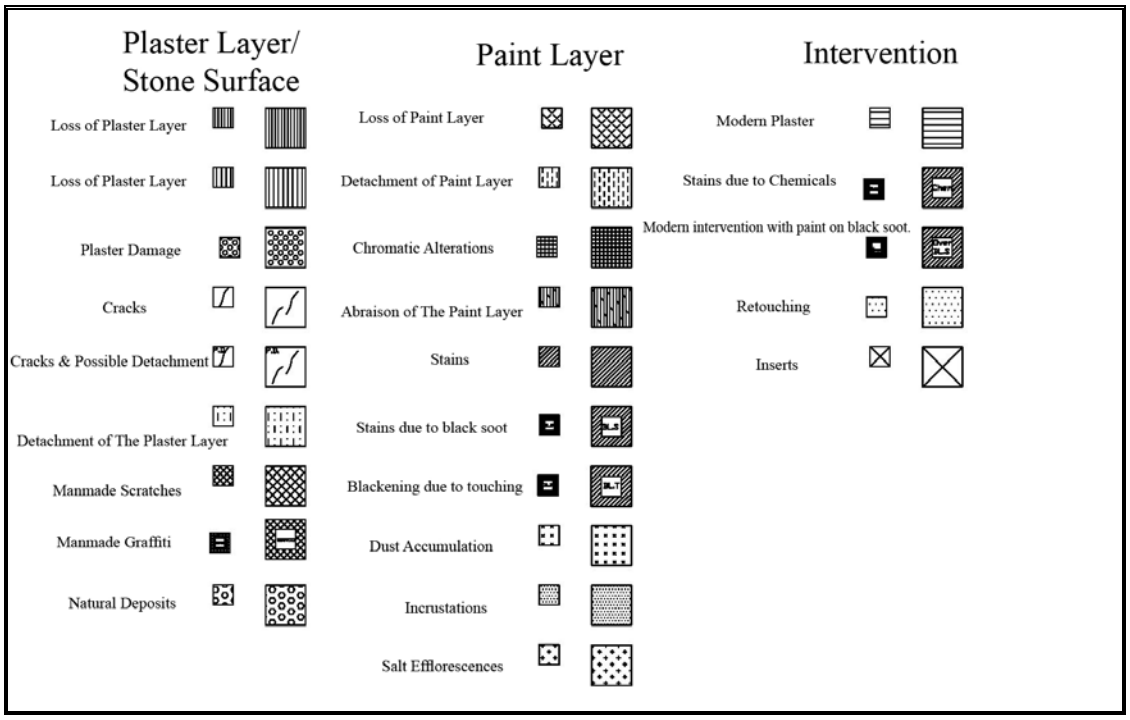

Figure 53: Guide to Conservation Symbols

5.2.2 Photographic Survey Methodology[5]

Figure 54: Matjaž Kačičnik, Photographer

The TMP has undertaken a photo documentation project for existing condition reports of tombs in the Valley of the Kings. The Theban Mapping Project, until the late 1980s, was focused on vertical aerial photographic coverage of 60km² of the Theban Necropolis. Then, in the 1990s, as excavation started in KV 5, the TMP shifted its focus underground and almost all decorated surfaces in KV 14 and KV 9 were photographed, from entryway to burial chamber. Parts of other tombs were also covered. For current condition reports, a complete record of tombs—each wall, each column, each ceiling—is needed. Since 2004, because of the scope of such a documentation project, limited time, and costs, the TMP decided to use digital cameras. For this work, our photographer, Matjaž Kačičnik, used a 6.1 Mega pixel digital SLR camera and a range of zoom lenses. Lighting the decorated surfaces of tomb walls was done with 1000-watt incandescent lights with umbrellas. Two to eight lights were used evenly to light the area being photographed.

The decision to use digital cameras meant that the TMP saved the expense of film, its processing, and scanning. But digital cameras require additional lenses, computer equipment, and computer image adjustment. We cannot avoid the dilemma of comparing film vs. digital images. Slide film still gives better quality than digital, but only if it is scanned with a top-quality scanner. Otherwise, 6.1 Mega pixel digital images are better. To get the best results, we shot in RAW format. To capture colours of painted walls accurately, the white balance of the digital camera had to be adjusted several times daily for each lighting setting.

Dust has always been an issue with any photographic system, whether on lenses or slide negatives or in the camera chamber. Most digital SLR's eventually end up with dirt on the sensor (actually on the low-pass filter protecting the camera's imaging sensor), resulting in smudges, blotches, and blobs on the final pictures. Today, dust is probably the biggest problem of digital SLR interchangeable lens cameras, and there is much dust in tombs, on floors, walls, and in the air. Therefore, handling photographic equipment has to be careful. Cleaning of equipment was performed on a daily basis but still after a while, we got dust on the camera's sensor. RAW format

[5]Photographic surveys compiled by Matjaž Kačičnik and Francis Dzikowski

enables us to reduce the effects of any dust that might be present using computer programs, which compare RAW photographs with a reference image on which only dust is visible. (A reference image is created by capturing a bright, featureless white object from a short distance). When there is too much dust on the sensor, it has to be cleaned with special fluid and sensor swab. That way, we were able to get the best quality images and an authentic copy of the area being photographed.

In the near future, we will have complete coverage of decorated surfaces in all tombs, from entryway to burial chamber, in high quality digital format, easy to access and easy to work with, for future study, conservation, engineering, or environmental work.

5.3 Tomb Environmental Monitoring

The condition of walls, plaster, and painted decoration in KV tombs can be seriously affected by changes in ambient temperature and humidity. It is therefore imperative that the temperature and humidity in KV tombs be constantly monitored and permanent records kept of the data. This is not currently the situation and therefore we recommend that loggers be installed on all open and potentially open tombs (Table 53). Depending on the length and design of a tomb, monitoring may require from two to ten data loggers, installed at such features as ramps or staircases, changes in axis, narrow gates, or other architectural features that can affect airflow.

Loggers should not be placed at floor or ceiling level but as near the mid-point of a chamber or corridor as possible to record ambient room temperature. Attaching them to wooden handrails, for example, is a good position, provided they are discretely positioned and securely mounted. Experience has taught that loggers that can be seen by visitors and easily removed are almost certain to be stolen.

The data loggers should be computer-compatible, able to store at least 60 days' worth of data when taking readings at ten-minute intervals, 24 hours a day. Downloading should be a task assigned to specially trained members of the KV conservation staff.

The records generated by these loggers should be stored in multiple copies in the offices of the SCA and its conservation units and maintained as a permanent environmental record of the tomb. It should be kept in mind that "the role of microclimate can only be established if the processes involved are followed in situ simultaneously with accurate measurement of the microclimate. Sophisticated and extremely precise measurements of the microclimate do not explain anything unless they are related to the real processes occurring *in situ*" (GCI, "Conservation of Wall Paintings," 125). Thus, accompanying notes should record any unusual activities in the tomb (cleaning, closure, heavy tourist traffic) so that these events can also be plotted in the environmental

record. Unusually high or low readings should be monitored, and accompanying records of visitors and any activities noted that might help explain these readings. Correlations with visitor figures should be noted, and the carrying capacity of a tomb may have to be changed if it appears that readings are too high or change too dramatically.

It has been clearly shown that the number of visitors in a tomb will affect temperature and humidity levels, but that effect is not immediate. There is a lag of two to three hours before visitors significantly raise temperature/humidity levels, and a lag of about one to two hours before their absence results in a decline. Thus, it is difficult to use changes in levels as a direct guide to controlling the number of visitors in a tomb. A warning system can, however, be installed in the most heavily visited tombs (such as KV 9 or KV 11), announcing that temperature/humidity levels have reached a pre-determined critical level. At such a point, the tomb can be closed for an hour or two, until readings return to an acceptable level.

What is an "acceptable level?" It is believed that decorated tomb walls are not adversely affected by high or low temperature/humidity levels, as long as they remain in a range above 10º C or 20 percent and below 30º C or 65 percent. Within those ranges, any figures are acceptable, providing they do not change too rapidly or too dramatically. It is the changes in level, not the level itself that poses problems. Ideally, then, an environmental monitoring system should be connected to an air conditioning or air exchange system that is turned on or off when certain temperature or humidity levels are reached. Such a system could maintain approximately constant levels, but only some of the time. An ideal temperature of 15º C ± 4º C, or an ideal humidity level of 50 percent ± five percent, for example, might be achieved 80 percent of the time, subject to the kind of equipment employed, the number of visitors, and the outside air quality. However, it would be expensive. (Because of the lag between tourist numbers and environmental changes, such a monitoring or warning system could not be effectively used to control of visitor numbers. For that, we believe that a system based upon the ideal tomb carrying capacity should be used, discussed below.

Furthermore, given that outside air temperature and humidity vary, given that tourists have a significant effect on the temperature and humidity in a tomb, and given that no long-term records of temperature and humidity levels in KV tombs exist, how do we maintain such constant environmental levels?

Previous studies lie thin on the ground, the only reliable information available is from the study carried out by the Getty Conservation Institute (GCI) in the tomb of Nefertari in the Valley of the Queens (QV) on the West Bank at Luxor.

Key Findings of the GCI

- Found entrance of one person causes rise in humidity
- When tomb closed a stable temperature and humidity are recorded
- Water vapour per person at 28C is 0.013 gm/min.
- Plaster used in repairs can increase humidity
- If air changed twice/hr, the water vapour of 60 people and C02 of 43 people can be removed

Therefore, to understand better the effect of visitors on the micro-environment of KV tombs, we selected one tomb in which to monitor temperature and humidity levels over a prolonged period. The tomb was KV 9, the tomb of Rameses VI (Figure 55). One reason this tomb was selected was that it was due to re-open to the public after a period of restoration at the time of our study.

5.3.1 Methodology

Figure 55: ERTCO Data Logger

The data loggers we used are from the Ever Ready Thermometer Company Inc (ERTCO), the RHTEMP101 is a miniature, battery-powered, stand-alone, temperature and humidity recorder (Figure 55). This device combines the latest in low power technology with Windows-based software to provide a Temperature and Humidity Recorder. Its real-time clock enables all data to be time and date stamped. Its reading rate is user-selectable and can range from one every two seconds to one per day. The start time and calibration are both programmable, as well as having the capability of alarming and real time monitoring. Once activated, the device measures and records 4,096 humidity and 4,096 temperature measurements simultaneously. The storage medium is non-volatile solid-state memory, providing maximum data security even if the battery becomes discharged. It is small enough to be unobtrusive nearly anywhere. Once the data is collected, retrieval is simple. The software enables users to select reading rate, device i.d., and initiate the start of data collection within moments after hardware is connected.

Ertco Data Logger Technical Specifications

- Calibrated Accuracy: ±0.5°C (0 to +50°C)
- Temperature Resolution: 0.1° C
- Temperature Range: -40° C to +80° C.
- Humidity Accuracy: 2% RH
- Humidity Resolution: 0.5% RH
- Humidity Range: 5 to 100% RH
- Operating Environment: -40°C to 80°C, 5 to 95% RH

As stated above, the tomb selected for our study was KV9, the tomb of Ramesses VI. This tomb is centrally located and is considered by many to be one of the most beautiful tombs in KV. In addition, the tomb had just re-opened after a period of restoration at the time of our study. Therefore, we knew we could expect high visitation figures during the study period.

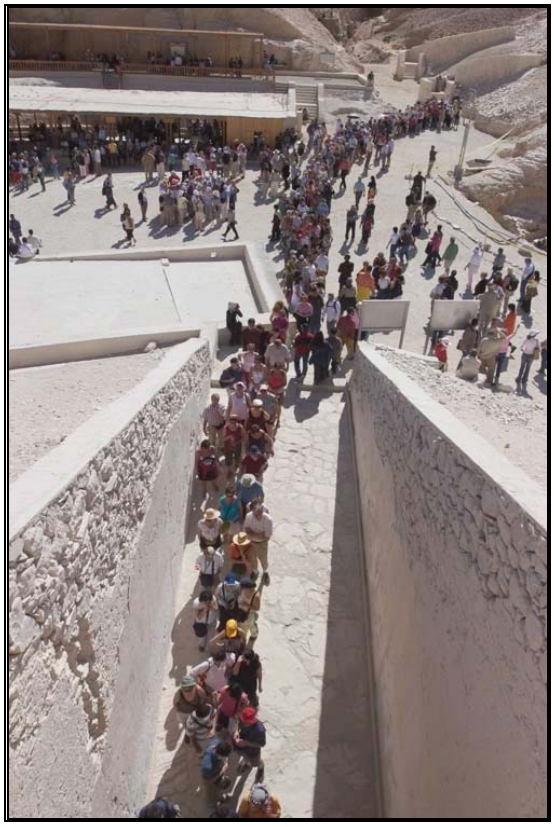

Figure 56: KV 9 Queues

We had six humidity and temperature recording devices available for use and these were positioned in KV 9 as in Table 54 and Figure 57. These were placed at regular intervals along the axis of the tomb and at positions where we knew groups of visitors would linger. The loggers were fixed at waist height to avoid dust from the floors and to utilize the readily available fixture point (the wooden handrail, positioned in the tomb about six inches away from the wall to encourage visitors from touching the reliefs). This height also made it easy to take readings (no need for a ladder or other more complicated methods). It also proved, however, to be a problem: we were concerned with the potential risk of vandalism and/or theft and unfortunately, this turned out to be a reasonable fear. On the first day of use, we had one logger stolen and over the period of the study (less than 12 months), we had all but one stolen. At a cost of $100 per unit, this is a substantial loss. If the loggers are to be placed in all open tombs, a suitable way of securing them will have to be devised to avoid further losses.

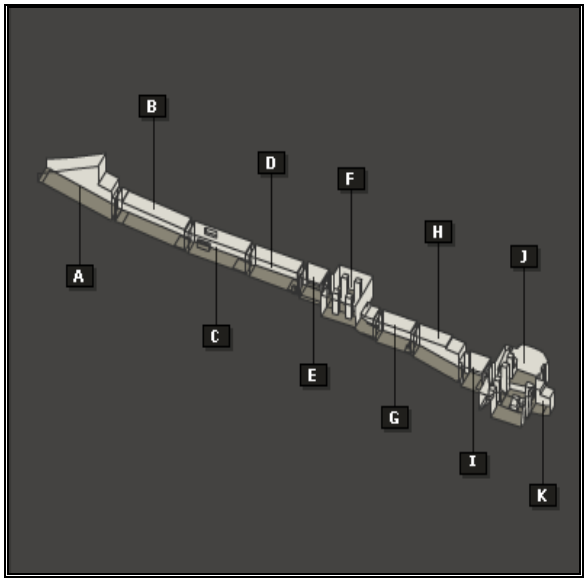

Figure 57: Plan of KV 9, with chamber desgnations

Serial No.	TMP No.	Postion
M17277	1	Outside
M17278	2	Chamber B
M1721	3	Chamber D
M17264	4	Chamber F
M17283	5	Burial Chamber
M17296	6	Burial Chamber

Table 54: Data Logger Positions

We recorded the data in three periods. These were:

1) September 12, 2004, to November 27, 2004

2) January 31, 2004, to April 9, 2005

3) June 14, 2005, to August 28, 2005

The tomb was closed to the public starting April 15, 2005.

5.3.2 Data Results

Over a period of 12 months, temperature/humidity loggers were installed in KV 9, at locations shown on the accompanying plan (Table 55). Their readings are shown on the accompanying charts.

Position	Temp High	Temp Low	RH High	RH Low
	C	C	%	%
Exterior	54.6	7.8	67	5
Chamber l	33.1	11.7	60	14.5
Chamber l	33.1	21.2	71	18
BC-Front	33.6	23.7	74	19.5
BC-Rear	31.6	21.4	76	18

Table 55: Data Logger Results KV 9, Sept. 12, 2004-Nov. 27, 2004

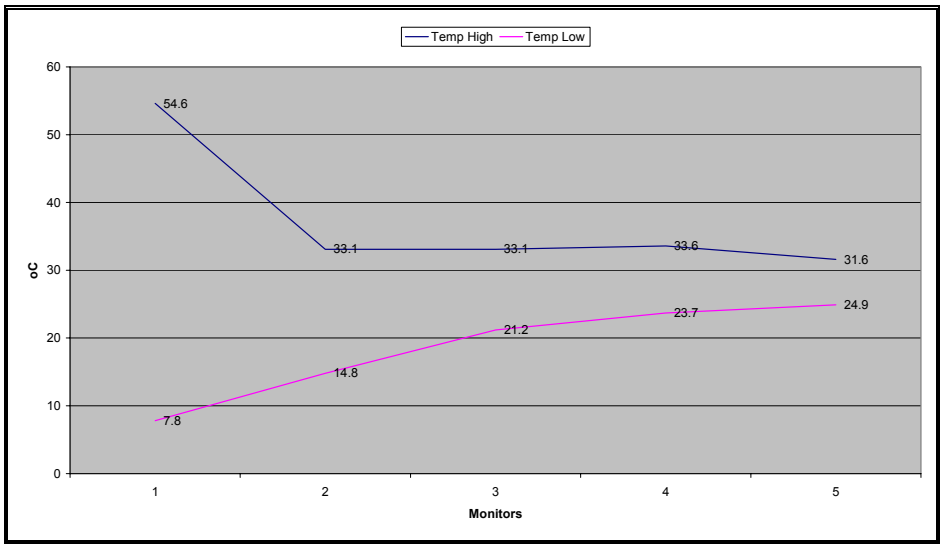

Table 56: Temperature Highs and Lows, KV 9, Sept. 12, 2004-Nov. 27, 2004

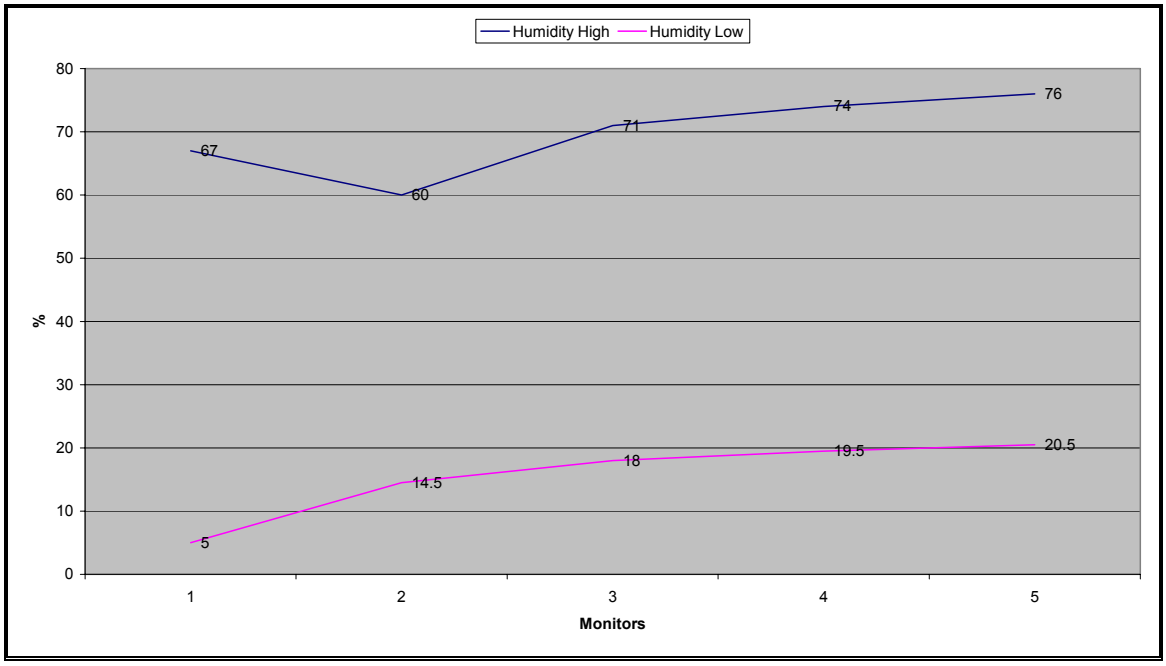

Table 57: Humidity Highs and Lows, KV 9, Sept. 12, 2004-Nov. 27, 2004

Position	Temp High	Temp Low	RH High	RH Low
	C	C	%	%
Chamber B	2.9.4	11.7	55.5	15.5
BC-Rear	29.3	21.4	71.5	18

Table 58: Data Logger Results KV 9, Jan. 31-April 9, 2005

Position	Temp High	Temp Low	RH High	RH Low
	C	C	%	%
BC Rear	27.8	27.2	34.5	26.5

Table 59: Data Logger Results KV 9, June 16-August 28, 2005

The second and third sets of results are derived from two and then one monitor, respectively, due to the theft of the other monitors. The third set of readings was also taken when the tomb was closed to the public.

The difference between the lowest temperature readings, usually at 0500, when the tomb had been closed for 12 hours, and the highest, at 1700, when it had been open for 12 hours, is unacceptable from a conservation standpoint. To leave this changing environmental pattern unchecked will almost certainly mean that significant damage will occur to the tomb's decorated walls and ceilings. It was for this reason the SCA decided to close KV 9 for an indefinite period starting April 15, 2005.

5.3.3 TMP Proposals

One possible solution to ensure the tomb's safety whilst maintaining access to the public is an air exchange system that extracts air from the tomb and allows natural currents to replace it with air from outside.

Another is to use an air exchange system that treats the air that enters the tomb, either by chilling it or by lowering its level of humidity.

A third solution is to install air conditioning equipment in the tombs. But many units are large, difficult to place without damaging the aesthetic of the Valley, are heavy users of electricity, difficult to maintain, and dependent upon water for their chiller units. Many archaeologists do not want to pipe water into KV because the possibility of broken pipes and leakage could pose an unacceptable threat. But these problems can be mediated, and an example of such an installation is detailed below.

One can do three things: 1. Set a maximum limit on the number of visitors allowed in the tomb at any one time, a figure to be determined by experimentation and careful monitoring of the environment or by using arbitrary figures of carrying capacity; 2. Install devices to control the environment and maintain temperature and humidity within a specified range no matter how many or how few visitors come into the tomb; or 3. Both.