

# Cave lighting in the early 21st century

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Over the past decade there has been a great deal of attention devoted to the subject of lighting show-caves, and many papers have been written and delivered on approaches to lighting various caves around the world. As a consequence of this focus, a series of 'first principles' have effectively been established to provide the current best practice guidelines for lighting or, as is more often the case, re-lighting, a cave. Work at Jenolan in particular in re-lighting the Imperial, Lucas and Temple of Baal has added significantly to establishing these principles. These basics are:

1. **Do not over-light:** A cave should be lit as a cave, and there should be no attempt to light the features as one would light an office or shopping mall. Subtle effects, the deliberate use of darkness, are often more effective and dramatic than the use of floods and 'blanket' lighting. Of course, the under-lighting of a cave should not be at the expense of the safety of visitors.
2. **Create a theme:** Rather than merely light a cave to 'make it pretty', lighting should be used as a tool to illustrate aspects of cave development, history etc. Avoid the "Thousand Shawl Effect", i.e. the somewhat forgivable tendency to light every single pretty shawl in the cave. Rather, lighting should be deliberately sequential, with each 'scene' leading logically to the next.
3. **Hide fixtures and cabling:** To the greatest possible extent without causing harm to the cave. The cave is therefore presented in as visibly natural a state as possible.
4. **Reduce power consumption:** This should be self-evident, not least for the clear environmental reasons of reducing CO<sub>2</sub> emissions, but also as reduced power requirements means greater possibility of supply via UPS during external power outage.
5. **Reduce heat:** The environmental impact of adding energy to the cave environment has been well documented in the scientific

literature. Use of appropriate luminaires greatly reduces this impact.

6. **Use available technology appropriately:** Remote controls, bus controlled electrical systems, high lumen per watt output lighting, batteries/inverters, optical fibres – all have a place in the arsenal of the cave lighting designer but should be used as tools to achieve an end, rather than as the end in themselves as the most advanced automation software and control interface is nothing without the design philosophy behind it.

In addition to this list of first principles, at Jenolan we have also become increasingly aware of the importance of design in the lighting of a cave in creating a total visitor experience. Work in the Lucas Cave focussed on the questions of 'what' and 'why'...what do we want people to see in the cave and why do we want them to see it? The Temple of Baal took us beyond the senses into the uncharted waters of deliberately targeting an emotional response and asking 'how', how do we want people to feel, and how can we make them feel this way?

With this list in place, and with the presence of this thoughtful rationale behind us, it could well be wondered what remains to be added to the discussion about cave lighting. However, our recent experience has led us to suggest that there is more to be said and, indeed, that cave lighting will continue to be a dynamic process due to the changing demands and expectations of our visitors. Specifically there are three aspects to be discussed: the importance of ensuring future capability and compatibility, the importance of having a collaborative effort and fusing technical knowledge with expertise in cave interpretation, and finally, expanding on the concept of targeting the emotional response of the visitor, we should recognise the importance of using cave lighting design to confront and surprise visitors.

## **Future Capability**

It is virtually impossible for any of us to imagine the technology of tomorrow. It can be easy to fall into the trap when replacing one lighting system with another to look with pity at the old system and wonder why it was installed in such a fashion, easily overlooking the fact that it may have been state of the art in its time and been installed with care and pride. Equally workers of the future may yet cast critical eyes over our recent celebrated achievements. Although it is impossible to predict what the exact shape of the future may be, it is possible to make some provision for advances in technology and to ensure that we will be able to adapt and incorporate, rather than be faced with the need to begin again from scratch.

The most obvious area in which to apply this philosophy is in the field of automation, control and data transfer. Rather than merely design a cave lighting system, we should be looking at parallel applications of technology in areas such as surveillance, remote access control and monitoring. The latter is a point often discussed but seldom implemented, however with the rapid evolution of environmental monitoring systems we would be remiss not to include the potential to incorporate them. Equally systems using Ethernet extenders on a single cat 5 data cable can be used to link the caves to a central data hub which serve as a high speed network enabling surveillance cameras and lighting to be controlled and monitored remotely. This has been used successfully at Jenolan in the development of the Nettle Cave self-guided tour. The forethought to install an optical fibre connection or a spare data cable now may well pay dividends in future years. As development of a cave is a labour intensive process, the maximum planning before work begins minimises future impact. A further Jenolan example is the concurrent installation of a water supply throughout every cave relit over the past decade.

## **Collaborative Effort**

This point is not recognised as it should be. Other than in genuinely unusual situations, a single person will not possess the complete range of skills and knowledge required to light

a cave to meet the fundamental list of first principles. This is addressed, at its most simple, by the pairing of an electrician with a cave guide or manager with experience in interpretation. Once again this may seem to be somewhat self-evident, but it has not always been acknowledged that the best electrician will not necessarily possess the knowledge of group movement and group dynamics, the essential pairing of lighting with interpretation, and the knowledge of environmental factors and cave conservation. Caving and SRT experience can also often be required in installing a cave lighting system and knowledge of minimal impact caving technique is essential. Equally, the best guide, caver or interpretive designer will struggle to realise the complex technical design required in this age of automation, and naturally the electrical work itself is impossible for non-qualified personnel. Hence we have the importance of a team, and a team that communicates and works collaboratively.

Once again we can look to the recent work at Jenolan to see the benefits of this collaborative approach. The actual lighting design for the Lucas and Temple of Baal came from the guiding staff, with guides also undertaking much of the labour in the sensitive cave areas. However the use of renewable energy technology, the uninterruptible power supplies (which are genuinely innovative, particularly the example of the Temple of Baal), and the control design and programming came from the Plant Electrician (who, unusually, also possesses formal qualifications in caving). Ultimately, it was the successful relationship between these elements that made the final product so much more successful than the 'old' management approach of appointing a single electrician the sole responsibility for re-lighting a cave.

## **Lighting that confronts and surprises**

This may be the most curious addition to the list, but in many ways it is also the most important. Here we recognise that 'progress' must always be measured and evaluated. It is often assumed that lighting 'evolves', and that this evolution is commensurate to technology and use of updated fixtures. However, this tendency can ignore the very factors that have made caves places of such wonder and delight

for centuries. One of these factors is that, for the overwhelming majority of people, caves are an unfamiliar, even confronting environment and that exploration into this unknown constitutes one of the prime reasons for visiting a cave in the first place. Hence we should not eliminate this element of confrontation, and cave lighting can be used to put visitors too much at their ease.

An excellent example of applying this philosophy is the recent relighting of the Temple of Baal, where quite deliberately the lighting was designed to confound visitor expectations. This was achieved through deliberate use of darkness as well as audio and visual effects.

Further to this we must recognise as cave lighting designers and, indeed, as managers and guides, that the context of interpretation has changed. Tourism as an industry is under threat from such alternate recreational pursuits as shopping, home entertainment systems and gaming. Our response to this threat must be to remain competitive and to offer an experience that is fresh, new and unexpected. We live in an age of media saturation where every visitor to a cave system can reasonably be expected to possess an existing frame of reference, something that was certainly not the case 100

years ago, and would have been relatively unlikely even 20 years ago. However, if we can exceed or confound these preconceptions and expectations we will ultimately deliver something far more memorable and meaningful to the visitor.

In conclusion, the past decade has seen a profound shift in our approach to lighting a cave. We have developed a far more thoughtful and analytical approach to lighting. Technology has changed and we have changed with it though we have also evaluated the available options for their suitability rather than blindly embracing them. We have attempted to look to the future as much as possible and to make provision for inevitable future advances. We have discovered the extraordinary value in creating the right blend of expertise to create a team capable of rising to the artistic, interpretive and technical challenges posed by the cave. And finally we have accepted that what was once good enough may, today, fail to be adequate stimulation when viewed against the changing expectations and preconceptions of our visitors. A 'traditional' product may also fail to be sufficiently competitive in the recreational environment of the early 21st century.

