VOLUME 42 2016 ISSUE 100

Helictite

Journal of Australasian Speleological Research

Major T.L. Mitchell del:

Day & Haghe Lith^rs to the Queen:

BRECCIA CAVE, AT WELLINGTON VALLEY.

London, Published by T & W. Boone

Helictite

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Helictite was established in 1962 by Edward A. Lane and Aola M. Richards, who were the foundation editors. It is intended to be wide ranging in scope from the scientific study of caves and their contents, to the history of caves and cave areas and the technical aspects of cave study and exploration. The territory covered is Australasia – Australia, New Zealand, the near Pacific Islands, Papua New Guinea and surrounding areas, Indonesia and Borneo.

In 1974 the Speleological Research Council agreed to support the Journal with financial assistance and in 1976 took over full responsibility for its production. From 1974 to 1997 the Journal was edited by Julia James assisted by other members of the Speleological Research Council Ltd. In 1998 Susan White and Ken Grimes took over as editors with Glenn Baddeley as Business Manager. Stefan Eberhard joined the editorial team in 2003.

Greg Middleton took over as Chief Editor in 2016. The accidental death of Ken Grimes in August led to further changes in editors, with Tim Moulds and Kevin Kiernan taking on the role.

In 2000 ownership of *Helictite* was transferred to the Australian Speleological Federation, Inc. and the journal has since been administered by the Helictite Commission of the ASF.

The aim of the Helictite Commission of the Australian Speleological Federation is to publish the results of scientific studies in all fields of speleology in *Helictite – Journal of Australasian Speleological Research*, and other publications.

Helictite in the Digital Era

Notwithstanding previous advice, this is the last issue of *Helictite* to be printed, in order to satisfy existing subscriptions. No further paid subscriptions will be accepted.

In future papers will be published online, and will be freely available to all. There will be no subscription fee – the ongoing costs of production will be borne by the ASF. Printed copies may be available, 'on demand', for a fee based on the costs.

Submitted papers will still be reviewed and edited as before, but the layout may be varied to suit a digital format. Each paper will be published on line as it is ready as part of what is intended to be an annual volume. Intending authors should read the latest 'Information for Contributors' on the *Helictite* website.

Helictite web site

The *Helictite* web site is part of the parent ASF site. The URL is: http://helictite.caves.org.au

The web site is maintained by Business Manager, Glenn Baddeley. It provides contact details, information for contributors, contents, abstracts and complete PDF versions of all papers in *Helictite*.

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Cover: "Sketch shewing the manner in which the Osseous Breccia occurs in the Cave at Wellington in New South Wales" illustrates the interior of Breccia Cave, Wellington Caves, by Thomas Mitchell. The first published version (with this caption) appeared in 1831 in Part 23 of the *Edinburgh New Philosophical Journal* and as such was the first published illustration of a Wellington Cave. The second, slightly revised, version, reproduced here, is a tinted lithograph from Mitchell's *Three Expeditions into the interior of Eastern Australia.* 2 volumes. T. and W. Boone, London. It is probable that these illustrations were based on the drawing which Mitchell records having prepared in his diary on 16 and 17 July 1830 [see page 35 herein]. (Scanned from the original by Bruce Welch.)

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The Speleotourist Experience: Approaches to Show Cave Operations in Australia and China

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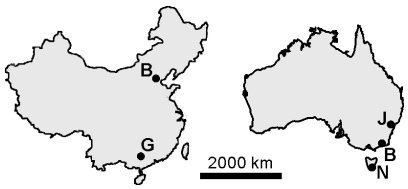


Abstract

This article provides a comparative study of commercial cave tourism in Australia and China, focussing on the methods of site interpretation and presentation used by selected show caves. The key point of contrast between the commercial speleotourist experiences offered in Australia and China is in the relative priority given to site conservation and framing the cave as a spectacle for the enjoyment of visitors. The discussion draws on the authors' field research, visiting show caves as tourists to consider the significance of developments in ecotourism and geotourism for show cave management in Australia and China.

Keywords: Show caves Australia; show caves China; show cave management; ecotourism; geotourism.

Introduction

The International Show Cave Association (ISCA) defines a show cave—sometimes called a tourist cave—as a 'natural occurring void beneath the surface of the earth that has been made accessible to the public for tours' (ISCA, n.d.). While some show caves offer 'wild' or 'adventure' caving, the vast majority of visitors walk in groups along well-lit concrete, gravel, steel-mesh, or even fibreglass pathways, pausing at intervals to listen to a guide's commentary about the cave's exploration or tourism history, its geological formation or significance, or the beauty and wonder of its features (Crane and Fletcher, 2015, pp. 159-87). Show caves, found on every continent except Antarctica, attract more than twenty million visitors globally every year (Lóránt, Lontai-Szilágyi, & Baros, 2010, p. 250) and can operate anywhere on the spectrum from theme park tourism to geotourism, from 'modern pleasure dome' (Davis 1996, p. 399) to 'natural underworld' (Barclay, McKeever, Humpage, Goodenough, & Lawrence, 2007, p. 42).

This article provides a comparative study of commercial 'speleotourism' in Australia and China, focussing on the methods of site interpretation and presentation adopted at selected show caves. Gillieson (2011) estimates that there are now more than 600 show caves open worldwide, but it seems likely that this figure does not include, or under-estimates, the number of show caves in China. Duckeck's (2015) show cave website lists 1256 show caves, including fifty-eight in Australia and sixty-two in China, but he has acknowledged that his records are partial due to a relative lack of information about Chinese show caves in English (Duckeck, 2012). According to Zhang and Zhu (1998) and Spate and Spate (2013), there are over 300 show caves in China. Further, Spate and Spate (2013) point out that 'Asian show caves … have enormous visitor numbers relative to the rest of the world' (p. 68). For example, Spate (pers. comm., 2015) states that 'Hwanseongul Cave, South Korea, had nearly 18,000 visitors on one day in 2001'.

Caves pose a series of challenges to tourism operators with regard to presentation and visitor numbers because of the fragility and irreplaceability of the very formations that attract the tourists. There is, in other words, an inevitable conflict between the functions of entertainment (mass tourism) on the one hand, and protection (ecotourism and geotourism) on the other. The Australian examples of the Jenolan Caves in New South Wales, Buchan Caves in Victoria, and Newdegate Cave in Tasmania provide useful case studies of Australian approaches to show cave management, and the efforts being made to conserve as well as display and interpret. The examples of Stone Flower Cave near Beijing, and three caves in and around Guilin in Guangxi province, southern China, illustrate Chinese approaches, which stand in marked contrast to those employed by Australian tourist cave operators. Indeed, Sofield and Li (2007) suggest that caves offer the clearest example of the stark differences between western and eastern approaches to ecotourism.

Our study is an exploratory one, which examines the assumptions guiding the management of show caves in two distinct national settings. It considers show cave tourism in relation to ecotourism and geotourism, and emphasises the responsibilities of operators in achieving a balance between display and conservation.

Ecotourism, Geotourism, Speleotourism

Cigna (2005) traces the origins of show cave tourism to Vilenica Jama, in Slovenia, where the Count of Petac was charging an entry fee as early as 1633. However,

popular cave tourism as we know it today in the West, really only took off in the nineteenth century when some of the great show caves of the world—including Postojna Jama in Slovenia, the Cheddar Caves in Britain, Mammoth Cave in the United States, and Jenolan Caves in Australia—were opened to fee-paying visitors. By the end of the century the speleotourist experience, which began with basic guided tours through natural passages, had expanded to include formed tracks, electric lighting, and rail lines to carry tourists in comfort. Of course, physical modifications designed to improve access for visitors inevitably degrade the speleothems that are the stars of the show (Russell and MacLean, 2008). More broadly, facilitating the entry of large groups of people in caves 'has the potential for altering the local climatic and environmental conditions' (Baker and Genty, 1998, p. 165), especially when heat-producing lighting systems are installed.

Popular speleotourism is based on the natural resources of caves: on the beauty and otherness of formations created by geological and hydrological processes over millennia in underground passages and chambers: stalactites and stalagmites, helictites and cave coral, flowstone and drapery. Show cave management today assumes that people visit caves to see the beauty, and experience the 'mystery', of the natural underground environment, and/or to enhance their understanding of speleology, with an emphasis on hydrogeology. The 'implied tourist' of most show cave operations has little knowledge of the various cave sciences; is hoping to see (and photograph) adequately lit, richly decorated 'cavescapes'; and wants to experience, as safely as possible, the otherworldliness of the dark zone of a natural cave.

Some speleotourism might usefully be seen as a branch of geotourism, a form of tourism based on the appreciation and conservation of the geology and geomorphology of the landscape and natural landforms (Kim, Kim, Park, & Guo, 2008). Geotourism, in turn, can be treated as a distinct form of ecotourism, tourism based on the sensitive use of natural resources. Weaver and Lawton (2007) summarise the three core criteria of ecotourism: (1) attractions should be predominantly nature-based, (2) visitor interactions with those attractions should be focused on learning or education, and (3) experience and product management should follow principles and practices associated with ecological, socio-cultural and economic sustainability. (p. 1170)

In relation to show caves, Weaver and Lawton's criteria are aspirational and difficult to dispute; however, for many caves they are impossible to achieve as the impact of tourism has already compromised their 'natural state' to the extent that their attraction will inevitably be closer to theme parks than geosites.

Geotourism is typically framed as niche or specialty tourism. However, our experience suggests that the majority of tourists around the world who join show cave tours are casual or incidental tourists, usually family or social groups, rather than cave enthusiasts. Hose (2012), who first defined the term 'geotourism' in 1995, traces its appeal to the '"Romantic" movement's greatest legacy to modern travellers and tourists': 'their preference to spend time appreciating aesthetically attractive "wild" or "natural" landscapes rather than the "controlled" and "brutal" spaces of mining and industry' (p. 8). This rings true whether geotourism is classified as niche tourism, or defined more broadly to include the full spectrum of people who choose to visit sites known or promoted for their geological or geomorphological distinctiveness. Thus, Kim *et al* (2008) refer to cave tourism as 'one genre of geotourism' (p. 301). Their choice of words, perhaps inadvertently, suggests the value of identifying and analysing the conventions that show cave operators employ to frame and interpret caves for visitors. The use of the term 'genre' chimes also with our experiences as participant-observers visiting show caves in Australia, China, America, Britain, Macedonia, and Slovenia between 2011 and 2014: the tourist experience of entering a show cave is remarkably consistent wherever one follows a guide underground. This consistency is both phenomenological – from the familiar subterranean smells to the absolute darkness of the inevitable moment when the guide shuts down the lighting system – and related to the content and structure of the guides' verbal commentary and the other textual elements of show caves, on tickets, brochures, and signage.

Show Caves in Australia

There are currently show caves open to the public in every state and territory of Australia, except the Australian Capital Territory. According to Spate and Spate (2013), there has not been reliable data of annual visitor numbers to Australian show caves for several decades (p. 57); however, their preliminary data sets from thirteen of Australia's twenty-four show cave operations (not individual caves) suggest that numbers have not fluctuated wildly over the last decade (p. 62). Field research for this section of the paper focused on caves in three states in southeast Australia: New South Wales, Victoria, and Tasmania.

Jenolan Caves

The Jenolan Caves in New South Wales—originally known as the Fish River Caves—are undoubtedly the birthplace of the show cave industry in Australia. While other caves, such as the Tasmanian caves around Chudleigh, were attracting visitors in the first half of the nineteenth century, as Hamilton-Smith (2003) argues, in Australia, 'the real development of cave tourism as an industry began at Jenolan' (p. 160).

The history of managed tourism at Jenolan Caves dates back to the 1861 visit of the local politician John Lucas, after whom Lucas Cave is named. Despite souveniring a large formation for his own collection

(Stone, 2012, p. 133), Lucas was very concerned about the damage being done to the caves by unregulated visitors and lobbied parliament for the site to be protected and managed. In 1866, thanks largely to the efforts of Lucas, an area of 5,000 acres in the district around the caves was proclaimed a reserve; a development Sheail (2010) identifies one of the 'earliest and most significant' (p. 40) efforts in Australia to set aside 'natural amenities' for the recreation and instruction of public. On Lucas's recommendation, Jeremiah Wilson was appointed the first official 'Keeper of the Caves' in 1867, a position he held until 1896 (Low, 2005, p. 103). As more caves were discovered and visitor numbers grew so did the commercial development both outside and within the caves. In the 1880s accommodation was built for visitors, while inside the caves pathways were constructed, wire protection was introduced to prevent further damage to the already vandalized speleothems, and permanent electric lights were installed in 1887 (Figure 1). In 1886, the *Sydney Morning Herald* proclaimed, 'The Jenolan Caves contain some of the most remarkable and beautiful objects in Australian wonderland.' (Anon, 1886). By the end of the nineteenth century Jenolan was well established as a major tourist destination in Australia.

The Jenolan Caves, which attract over 230,000 visitors each year (Jenolan Caves, 2012), are an impressive example of the way tourism can sit comfortably alongside exploration, technical innovation, and scientific research in show caves. In 2013, Jenolan Caves achieved Advanced Ecotourism Certification from the not-for-profit organization Ecotourism Australia and promoted their recognition as 'one of Australia's leading and most innovative ecotourism providers, committed to best practice in using resources, conserving the environment and helping local communities' (Jenolan Caves, 2013). Ten caves at Jenolan have been developed and are open for regular guided tours: Lucas Cave; River Cave; Chifley Cave (known as the Left Imperial Cave until 1952); Imperial Cave; Orient Cave; Ribbon Cave; Pool of Cerberus Cave; Jubilee Cave; Temple of Baal Cave; and Nettle Cave. The Lucas Cave tour offers a traditional speleotourism experience in which large groups are guided through a series of passages and chambers; the centerpiece of the tour, the large Cathedral Chamber, is also used for weddings and regular concerts. Each Lucas Cave tour can accommodate up to 65 people, and is the most popular with visitors. At the other end of the spectrum, the Pool of Cerberus tour caters for a maximum of eight people on a tour. Professional guides conduct all Jenolan tours, except the Nettle Cave tour. Nettle Cave, which was closed to the public in 1932, was reopened for self-guided tours in 2006, with the commentary available in eleven languages (one of which is Klingon!). On the whole, however, like other Australian show caves, Jenolan caters mainly to an English-speaking market (albeit one which includes an increasing number of visitors for whom English is a second language).

Figure 1. Electric lighting from the 1880s still in situ, *Off the Track* tour, Jenolan.

The two-hour Off the Track tour, which is limited to groups of fifteen, falls somewhere between a show cave tour and adventure caving. Visitors are provided with a helmet and headlamp and taken through former show cave pathways no longer on the regular tour itinerary.

In common with several show caves around the world, Jenolan's tourism operation is supported by an historical society—the Jenolan Caves Historical and Preservation Society—which has its own website and publishes occasional papers and booklets as well as a quarterly newsletter. Research carried out by scientists from the Commonwealth Scientific and Industrial Research Organisation (CSIRO), the Australian Museum, and Sydney University, in cooperation with the Jenolan Caves Trust, has shown that the Jenolan caves date back more than 340 million years, making the complex the oldest known open cave system in the world (Osborne, Zwingermann, Pogson, & Colchester, 2006).

The number of visitors allowed on each tour raises the issue of the sustainability of a traditional market-driven model in show cave management (Doorne, 2000). At Jenolan this is addressed through a balance between what are referred to in speleological circles as 'sacrificial caves', such as the passages and chamber visited by large groups on the Lucas Cave tour, the better protected areas visited by smaller groups on the Pool of

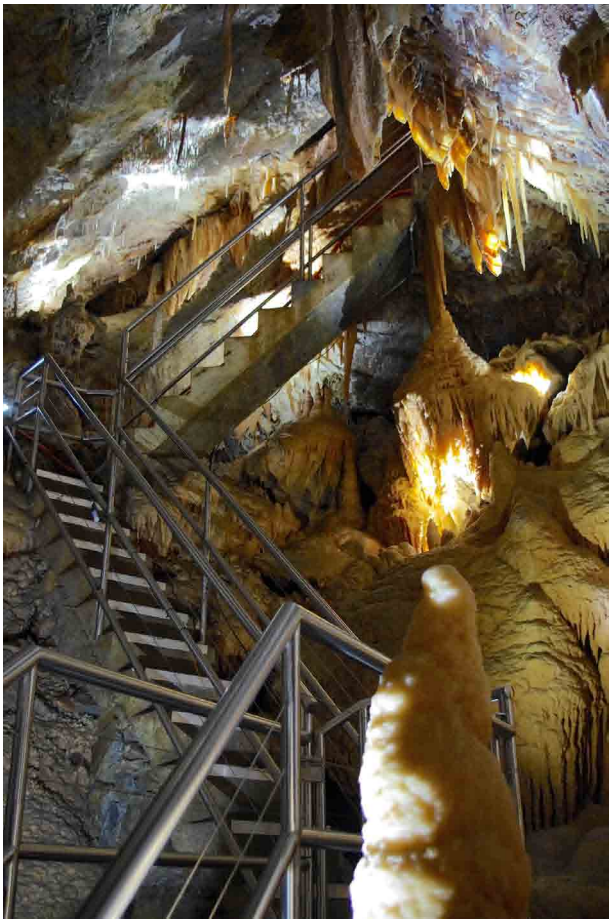


Figure 2. Orient Cave, Jenolan, showing the stainless steel railings.

Figure 3. The outside of the excavated entrance to Royal Cave, Buchan.

Cerberus tour, and those cave sections not open to the public. Additionally, old iron rails are being replaced with stainless steel ones (Figure 2), and cave formations are carefully cleaned to remove the accumulation of lint left by visitors.

Buchan Caves

In 1897, a local newspaper, the *Bairnsdale Advertiser and Tambo and Omeo Chronicle*, reported that the 'great caves at Buchan, and the scenery in their neighbourhood … are well worthy alike the attention of the geologist and tourist, the scientist and the mere lover of the beautiful in nature' (quoted. in Clark, 2014, p. 42). Five years later, the same newspaper published an article claiming that the caves had been 'almost completely stripped – denuded of almost the last stalactite' (Clark, 2014, p. 42). As with other Australian cave tourism developments there was an early tension in Buchan between visitors who collected souvenirs from the caves and those who recognised the importance of conservation and the need for careful management of the environment, if the resource was to bring economic benefit to the area in the future.

The Buchan Caves, now part of the Buchan Caves Reserve in Gippsland, are managed by Parks Victoria and are EcoCertified by Ecotourism Australia. Guided tours of two caves, Royal Cave and Fairy Cave, operate on a daily basis attracting over 100,000 visitors per year. Both are well lit, with good walkways and world-class decorations including large calcite rimpools in Royal Cave and ornate stalactites, stalagmites, and shawls in Fairy Cave. Additionally, historical tours of Federal Cave, closed to the public in 1970, are now offered several times a year.

After proceeding through a sixty-metre man-made entrance tunnel (Figure 3), the Royal Cave tour takes visitors through five chambers and 500 metres of the three-kilometre long cave. From 1913, when the first visitors were guided through the cave, to 1920 candles illuminated the passages and formations. These were replaced by electric lights, powered by a generator, which operated for the next fifty years until mains power (with wires fed inconspicuously through the handrails) was introduced in 1970.

The Fairy Cave was discovered by Frank Moon in 1907 and opened to the public later that year. Like the Royal Cave tour, the present-day Fairy Cave tour takes visitors along a 500-metre route through five highly decorative chambers. The largest of these, the Kings Chamber (Figure 4), was the site of the wedding of Fairy Moon (the daughter of Frank, who named her after the cave) and Frank Hansford on 14 April 1930.

Many of the formations in this cave are named from Shakespeare's *A Midsummer Night's Dream*, and

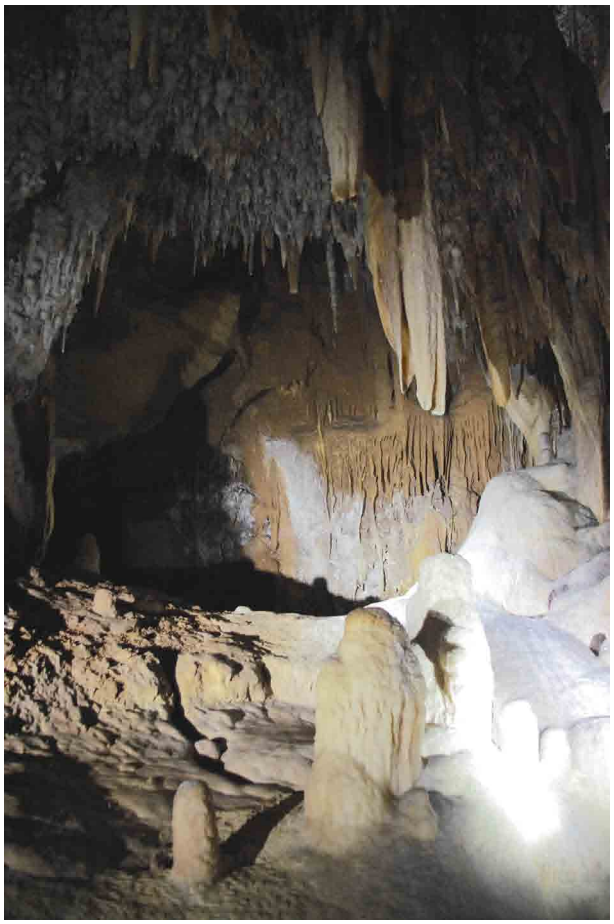


Figure 4. Kings Chamber in Fairy Cave, Buchan, the site of Fairy Moon's wedding.

consequently the cave interpretation provided by the guides previously focussed on fairies. For the last fifteen years, however, such non-scientific entertainment has given way to an informative, geology-based explanation of the formations. This cave is now lit by 12-volt LED lights, and is one of the few show caves in Australia to use a specially designed wheelchair to provide disabled access to part of the tour. [1]

Tour sizes in both caves are limited by the morphology of the passageways, with Royal Cave able to accommodate tours of up to thirty, and Fairy Cave tours of up to twenty.

Federal Cave was also developed as a show cave, but was closed to tourists when mains power was connected to Royal Cave and Fairy Cave in 1970. Since 1988 the Friends of Buchan Caves group has been re-habilitating the cave, removing most of the old electrical equipment and handrails, installing a wash-water system and solar-powered pathway lights, laying fibreglass pathways, and restoring the calcite formations. It is now open to the public several times a year, usually during school holiday periods, with a maximum of ten people on each tour, though occasionally, in particularly busy periods, consumer demand outweighs consideration of carrying capacities that would better aid conservation, and groups of up to twenty are allowed through. Visitors are provided with helmets and headlights, lending this historic tour a sense of gentle adventure. Like the more strenuous Off the Track tour at Jenolan Caves, this tour responds to a market for a differentiated approach to show cave tourism that provides a sense of daring without the challenge or risk associated with 'wild' caving.

1 Tantanoola Cave in South Australia has been wheelchair accessible since 1983; like Fairy Cave, Jillabenan Cave (Yarrangobilly Caves) in New South Wales has limited wheelchair access using a specially adapted wheelchair.

Newdegate Cave

Newdegate Cave, in Tasmania's Hastings Caves State Reserve, is the largest dolomite tourist cave in Australia. Unlike Jenolan and Buchan, Hastings Caves has not been accredited by Ecotourism Australia. The Tasmanian Parks and Wildlife Service, a government agency, administers Hastings Caves. Cave sites are unusual in this respect as most other nature-based attractions in Australia are operated by the private sector (Weaver and Lawton, 2007).

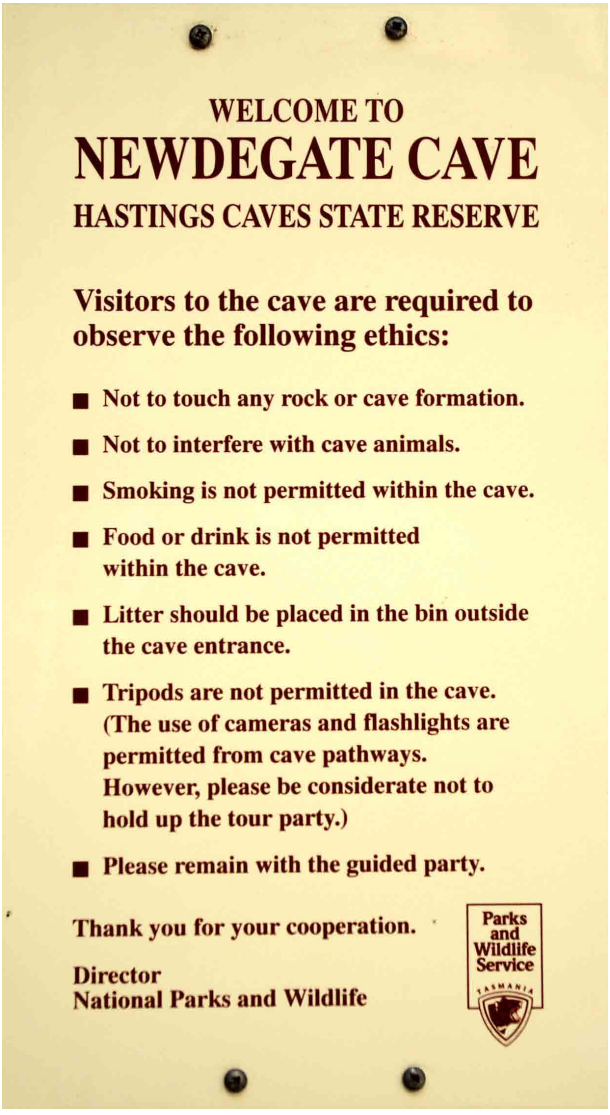


Figure 5. Code of Conduct for visitors displayed at the entrance to Newdegate Cave.

Speleotourism.

As Higham (2007) explains, 'The viability of ecotourism operations clearly hinges on two fundamental requirements: (1) A resource base that demonstrates some degree of naturalness and (2) The infrastructure that is fundamental to commercial tourism operations' (p. 8).

These two requirements are evident in the tourism infrastructure at Hasting Caves. After purchasing tickets (which include use of the thermal pool and barbeque facilities) at the Visitor Centre, there is a five kilometre drive followed by a five-minute walk to the cave entrance, where visitors congregate in a wooden shelter prior to the commencement of their tour. Signage in the shelter clearly sets out the ethics visitors must observe while in the cave (Figure 5), which aim to minimise the damage to the fragile subterranean environment.

Show Caves in China

Based on the number of caves open to paying visitors, the Chinese show cave industry is roughly six times the size of Australia's; and if reliable figures of annual visitor numbers were available, the distinction between show cave tourism in the two countries would probably be even greater. The authors' experience conducting show cave field research lends weight to this assumption. On their visits to the three Australian sites discussed above—all during off-peak periods—they never queued to purchase a ticket and were rarely on full tours. In contrast, experiencing show cave tourism in China involved standing in very large, noisy queues of visitors waiting to join tours, endeavouring to stay with the party as different tour groups overlapped, and losing sight of guides who use individual microphone systems to compete with each other for attention in the crowded caverns. Many of China's show caves are in the karst areas of Guizhou, Guangxi, Hunan, Jiangsu, Szehuan, Yunnan, and Zhejiang provinces—though there are tourist caves visited predominantly by locals in many other regions, too. Field research involved visiting four caves: Stone Flower Cave in the Fangshan District near Beijing; and three caves located amidst the stunning karst topography around Guilin in Guangxi province, Reed Flute Cave, Crown Cave, and Silver Cave.

The development of show caves in China has followed the global pattern of guided tour groups being led along concrete pathways through brightly lit caves, with some, like the Reed Flute Cave close to Guilin, offering additional events such as underground dinners. In the majority of show caves in Australia, Europe, and the United States electric lights are operated only intermittently and dimmed to minimize the growth of algae and display the caves in as natural a way as possible (given that there is no natural way to see a deep cave as its natural state is absolute darkness). In China, however, show caves invariably feature bright coloured lights and neon signs.

Stone Flower Cave

The Stone Flower Cave—ninety kilometres from Beijing and twelve kilometres from the Peking Man Cave at Zhoukoudian—is one of the biggest show caves in China, and a remarkable cave by any world measure. Yet, perhaps because of its proximity to the more famous tourist sites of Beijing, including the Forbidden City and the Great Wall, the cave is not promoted to overseas visitors. Getting to the cave involves the would-be speleotourist negotiating either a series of local buses or a combination of the subway and a shuttle bus, or opting for a full-day sightseeing tour, which includes the cave as one of several attractions outside the capital. Even hiring a tourist car (the best option) is likely to involve frequent stops for directions, as the attraction is off the beaten track for international tourists.

Four of the eight mapped levels of the cave system are now open to visitors, who descend 150m beneath the surface and walk 2.5km through sixteen halls during their two-hour underground tour. The well-preserved speleothems include huge stalactites and stalagmites, two stone shields, a stone flag, and a large stone curtain. The whole breathtaking experience is illuminated by a fairyland of coloured lights that lends a surreal atmosphere to the spectacle (Figure 6).

Despite the abundance of coloured lighting, which is frequently used to emphasise non-scientific interpretation

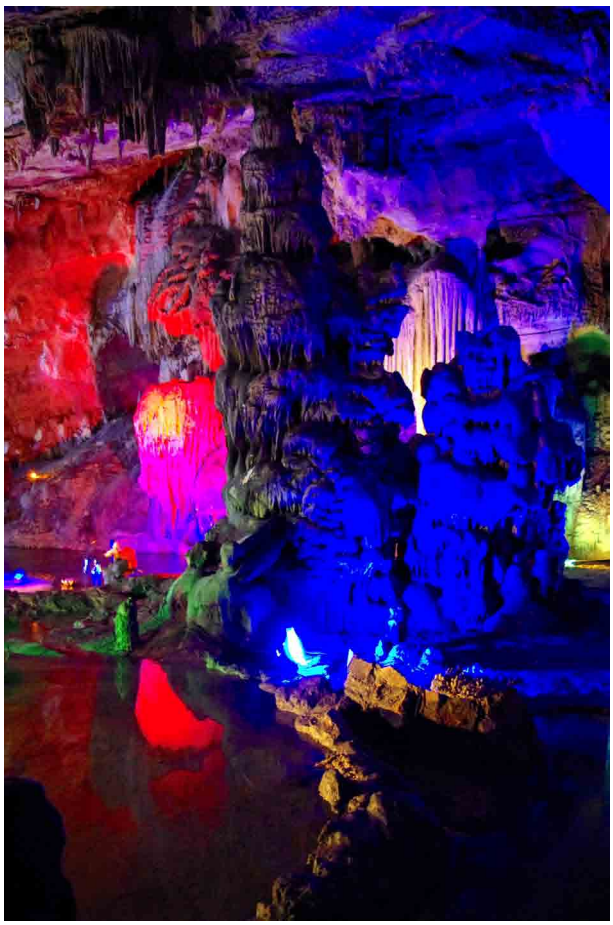
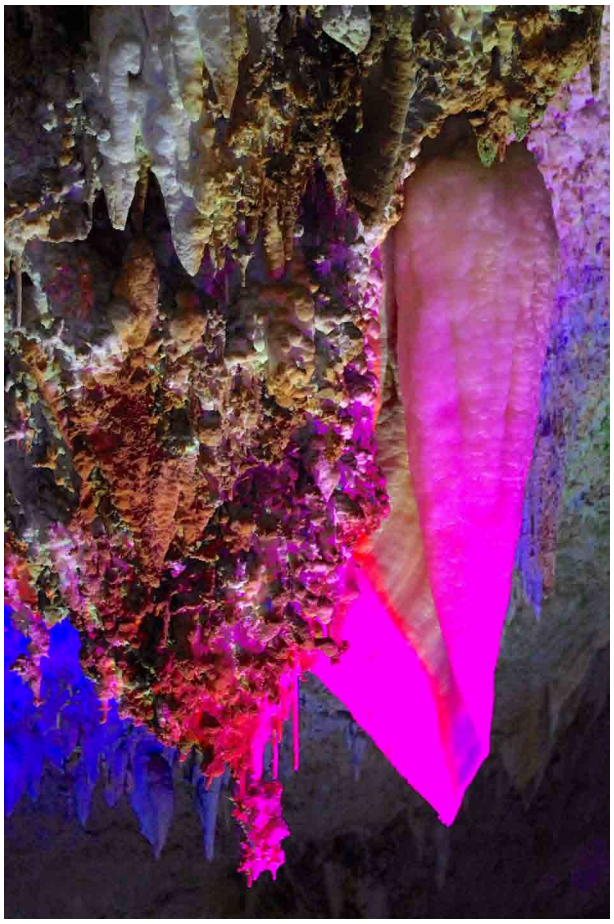


Figure 6. Coloured lights, Stone Flower Cave.



Figures 7a and 7b. (above)
Stone Flag formation and accompanying signage, Stone Flower Cave.

Figure 8. (left)
Signage at Stone Flower Cave.

of the formations as flora or fauna, common in Chinese caves, there is a degree of scientific interpretation (in both Chinese and English) to educate visitors as well as entertain them (Figures 7a and 7b). There is also a firm awareness of the need to protect the formations in the cave, which is reinforced by the guide and by regular signage along the tour route (Figure 8).

Reed Flute Cave

Reed Flute Cave is one of the most popular tourist destinations around Guilin, and the tour is included on almost all local tour itineraries. The principal formations are stalactities, stalagmites, and pillars in a series of huge chambers, all brightly and colourfully lit. As is frequently the case in China, there is only limited English-language signage at Reed Flute Cave, and little attempt is made to cater for foreign tourists, perhaps because this cave, like others in the area, attracts so many domestic tourists. Tours are conducted only in Chinese, though foreign tourists can arrange a private tour with an English-speaking guide, and package tour groups are accompanied by their own guides. The one-hour tour takes visitors on a simple U-shaped route of about 250m. Tour groups are very large in number, and times are not

staggered, meaning that groups often overlap, and visitors are able to wander off by themselves or switch from one group to another. Sofield and Li (2007) note that 'the Chinese worldview privileges literary and cultural heritage before the sciences' (p. 378). This perhaps explains the emphasis of the commentary at Reed Flute Cave on human interpretation of the speleothems—their resemblance to silhouettes of animals (particularly lions), or plants, or vegetables—rather than on the geology of the formations. The Aboriginal poet Oodgeroo Noonuccal (Kath Walker) references this non-scientific interpretation in her poem 'Reed Flute Cave'—inspired by her visit in 1984—when she writes 'Mushrooms and every type of fruit, / Vegetable, animal and fish / Are on display' (Walker, 1988, p. 53). The formations—with names such as Crystal Palace, Dragon Pagoda, Flower and Fruit Mountain, Snowman—are colourfully lit to the point of detracting from their natural beauty. The cave walls carry inscriptions dating back to the Tang dynasty. The guides are well rehearsed, and frequently have their groups laughing out loud. They also entertain their flock with folk songs from the local Dong minority tribe, and there are numerous commercial photo opportunities during the course of the tour. Surprising to the western tourist, little or no attempt is made by the guides to discourage visitors from touching the formations within their reach, and consequently there is visible evidence of the considerable damage that has been done (and continues to be done) to the cave by visitors.

Crown Cave

Crown Cave, which opened to tourists in 1995, is located in Caoping village, 29km south of Guilin. Taking its name from the crown-like crag that rises above the cave, it is a popular stop for tourists on Li River cruises or bus excursions from Guilin. Large tour groups travel in different directions from a series of starting points. There appears to be no staggering of groups and there is considerable focus during the one-hour tour on commercial photo opportunities and stalls selling everything from jewellery made from the cave formations to chilli products (Figure 9).

The anthropocentric Chinese worldview (Sofield and Li, 2007) encourages cave tourism operators to alter the natural environment to facilitate the 'improvements' expected by their visitors. This is particularly evident in Crown Cave, which, apart from the usual concreted paths and bright coloured lights, proudly claims to have been listed in the *Guinness Book of World Records* as the cave with the most ways of travelling. Apart from walking, the visitor can journey through the cave aboard a sightseeing slide, a boat, a train (Figure 10), and a glass-fronted 'sightseeing elevator' which carries tourists up or down the side of the largest chamber on the tour: or as the China Odyssey Tours website grandly puts it, 'a combination of sea tour, land tour and air tour' in a single cave (China Odyssey Tours, n.d.).

This is a cave that largely serves the domestic tourism market. When one of the authors visited the cave he did not see another non-Asian visitor among the more than 1000 people he counted in his and several other large groups encountered during the three-kilometre route. This is in contrast to Reed Flute Cave which is popular with foreign tourists, probably because it is only seven kilometres from the centre of Guilin and thus easy to access.

Silver Cave

Visitors to Silver Cave in Lipu County, 85km south of Guilin, follow a two-kilometre trail that encompasses two levels of the extensive cave system. The hour-long tour is divided into three sections: the lower cave; the grand hall; and the upper cave. The groups at this cave are smaller and more organised than at Crown Cave, and on the tour taken by one of the authors, the guide clearly had the attention of the whole group throughout. The

Figure 9.
Souvenir stall
inside Crown Cave.

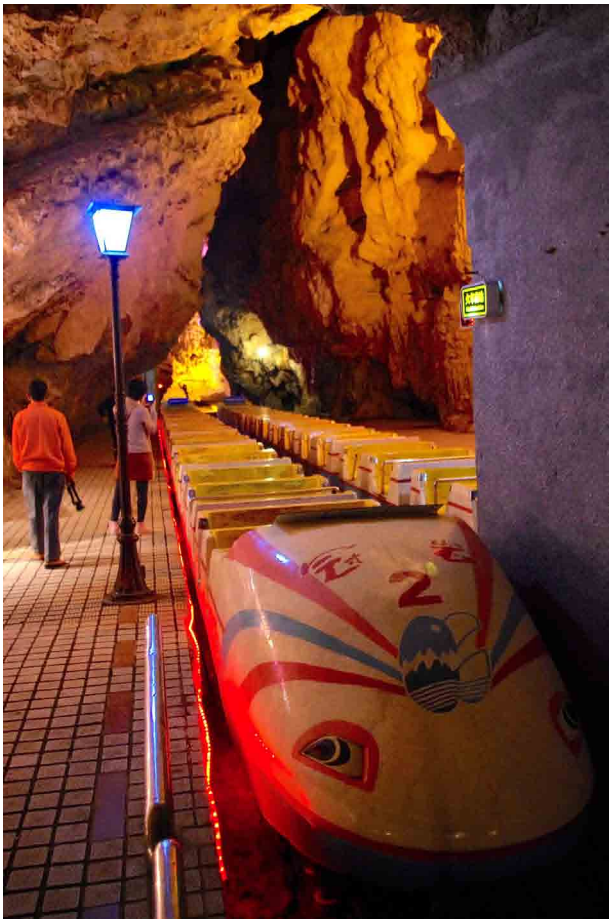


Figure 10. Train 'station' inside Crown Cave.

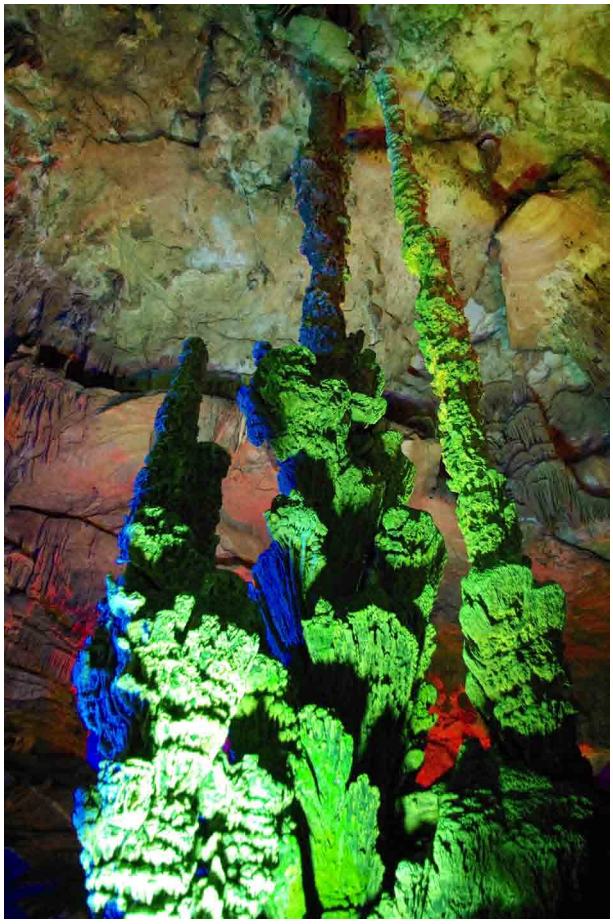


Figure 11. Coloured lighting, Silver Cave, highlighting non-scientific interpretation.

formations in this cave are very impressive; however, the focus is again on what they resemble rather than on the geology of the cave.

The coloured lighting which is predominantly used to enhance non-scientific interpretations of the formations, such as their resemblance to vegetables (Figure 11) does not facilitate education or help promote the type of visitor behaviour that will preserve the cave resources in the long term.

Conclusion

Australian show caves have two main things in common with their counterparts in other parts of the world including Britain, Europe, the United States, and New Zealand: first, environmental and conservation concerns influence the nature of the speleotourist experience, and how the caves are managed; second, the interpretation offered will be geologically based. In show caves in all these areas pathways are designed to allow visitors to see the cave features, while rails or occasionally caging limit the potential damage to formations. Interpretation in these caves, whether in the form of signage, or the commentary of the tour guide, is intended to inform visitors about the geology and history of the site. It is primarily educational, with an emphasis on historical popular science. Lighting is invariably white, and low-level. In our experience, once underground the show cave tourist loses a certain sense of place when infrastructure and tours are based on shared cultural norms, which is increasingly the case across Australasia, Europe, and North America: a show cave is a show cave whether the visitor is in Australia or America, Britain or Slovenia.

Mass cave tourism in Australia, particularly as it was practised in the nineteenth century, has caused significant and irreversible damage to the very features that visitors now wish to see. However, sites such as the Jenolan Caves complex have put in place measures to conserve the remaining natural cave resources. Specifically, significant efforts have been made in recent years to reduce the pollution caused by visitors—including lint from clothing, skin flakes, hair, mud brought in on shoes, and increased levels of condensation and carbon dioxide gas—and to reduce the negative effects caused by the installation of visitor facilities such as concrete pathways and steel rails (Russell and MacLean, 2008).

Tour guides also routinely include snippets of environmental awareness education with the standard geological or biological commentary. Thus cave tourism in Australia operates increasingly within the broad definitions of ecotourism and geotourism, a trend which is bound to continue as more cave sites become involved in Ecotourism Australia's Geotourism Forum, launched in 2013 at the Global Eco Asia Pacific conference. The

Speleotourism.

Geotourism Forum brings together Ecotourism members with the stated purpose of 'working to "add value" to Australia's nature-based tourism offering' (Ecotourism Australia, n.d.). It remains to be seen how effective the forum will be in exploring 'how best geotourism can be promoted' and furthering 'Ecotourism Australia's interest in inspiring environmentally sustainable and culturally responsible tourism'. More pertinently for the topic of this article, the Forum's statement of member benefits begins with the opportunity to join 'a networked grouping dedicated to the development and advocacy of emerging links overseas, particularly China'. According to Ecotourism Australia's 'Blueprint for a Sustainable Future' 'Geotourism is a well established form globally, and particularly in China' (Ecotourism Australia, n.d.).

As long ago as 1985, Chinese geologists proposed 'the establishment of geoparks in geologically significant territories in order to enhance their conservation and improve geoscientific research' and China was one of the first countries to actively support the UNESCO Geopark programme (Dowling and Newsome, 2006, pp. 141-142). Nevertheless, in China, the enormous popularity of show cave tourism (measured by visitor numbers and the number of caves that are open to the public) is not yet matched by a universal awareness of the need for environmental protection, or a limit to visitor numbers based on the assumption that overcrowding reduces the quality of the visitor experience (Doorne, 2000; Hamilton-Smith, 1994). In part this may be because, as Doorne (2000) has shown, cave visitors from north Asia have a higher tolerance of crowding compared to Australian visitors. Further, the space in caves is finite and therefore it is reasonable to conclude that the risk of damage to the caves is likely to increase with the size of the group. While there is awareness of the value of the natural cave resources and the need to protect the delicate environment in Stone Flower Cave, in the majority of Chinese show caves visited during our research little or no real effort had been made to protect the formations, and unless there is a significant shift in attitudes and practices damage to the caves will continue. Apart from the accumulations of lint and lampenflora, there is also an accumulation of litter in Chinese caves; these all contribute directly to the deterioration of the environment on which the industry ultimately depends.

Show cave tourism in China, then, currently operates outside the definitions of geotourism and ecotourism—despite evidence that there has been some growing adoption of the concept of practice of geotourism in China for some decades—focussing instead on socio-economic benefits for the region through exploitation of geo-resources. If China is going to become a world-class cave tourism destination that attracts foreign tourists and creates wealth for the region it will need to address the conflict between mass tourism on the one hand and nature-focussed on the other, which has already altered the ways caves are developed and managed for tourism in Australia.

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The discovery of a Dodo *Raphus cucullatus* Linn. (Aves, Columbiformes) in a highland Mauritian lava cave

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Abstract

In September 2006, during a survey of Mauritian caves for cockroaches (Blattodea), a skeleton of a Dodo (*Raphus cucullatus* Linn. 1758) termed 'Dodo Fred' was serendipitously discovered in a highland lava cave. It was subsequently removed from the cave for curation. It is only the second individual associated skeleton to be found, the only one recorded in context and in modern times, and has been called 'the most scientifically important Dodo in the world'. This paper records the circumstances surrounding its discovery, and provides additional information concerning other Dodo subfossil deposits. The preservation of bone material in lava tubes is also discussed. The publication of this paper has unfortunately been considerably delayed, so some of the factual content is no longer novel.

Keywords: Dodo; subfossil; associated skeleton; Mauritius; lava cave

Mauritius and its caves

The isolated island of Mauritius is situated in the southwestern Indian Ocean, lying about 850 km east of Madagascar. It is 65 km long and 45 km wide and has a land surface area of 1,825 sq km. Mauritius, with its dependency Rodrigues, 560 km to the east, and the French island of Réunion, 160 km to the south-west, comprise the Mascarene Islands (Fig. 1).

The main island of Mauritius is almost entirely volcanic, having originated about 13 million years ago in seabed eruptions, emerging above sea level about 8 million years ago (Saddul 2002). The island is dominated by two spectacular mountain peaks, remnants of two large volcanic craters, and there are a number of smaller and more recent craters, including Trou aux Cerfs, Grand Bassin, Bassin Blanc and Trou Kanaka (Fig. 2). The main volcanoes have been extinct for at least 200,000 years though some lava flows may have occurred as recently as 26,000 years BP, particularly in the Plaine des Roches area in the north-east (Antoine 1983; Saddul 2002).

Lava tube caves are widely scattered across the island; Middleton (1998, 2005) has documented over 150 since 1992. There are also a few karst caves in aeolian calcarenite, mainly on the south and east coasts of the main island of Mauritius and in the south-west of Rodrigues Island.

History of the Dodo and its discovery

The Dodo (*Raphus cucullatus* Linn. 1758) was endemic to Mauritius, and disappeared soon after its discovery. It is the first species widely recognised as having become extinct due to the action of humans (either through direct hunting, habitat alteration or introduction of predators and competing species), and has become a true icon of extinction (Hume 2006). The exact date of extinction is unknown, but the best estimate, based on contemporary records, appears to be about 1693 (with a 95% confidence interval of 1688 to 1715) (Hume and others 2004). Therefore any bones found since 2000 would have to be at least 300 years old.

In the first half of the 17th century, Dodos were regarded as curiosities but surprisingly few were taken from Mauritius alive or dead. A stuffed specimen had been on display in the Ashmolean Museum, Oxford, England since at least 1656, but by 1755 it had deteriorated to the extent that only the head and one foot remained (Nowak-Kemp & Hume 2016). These unique skin specimens still reside in the University Museum of Zoology, Oxford (Fig. 3). A second foot existed in London until the late 19th century but its whereabouts is now unknown (Hume and others 2006). Together with a skull in Copenhagen and an upper mandible in Prague, these remnants constituted the world's inventory of Dodo material prior to 1865 (Fuller 2002).

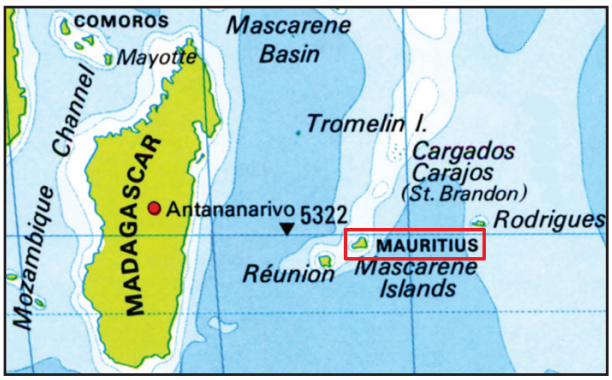

Figure 1. Location of Mauritius, in south-west Indian Ocean.

The discovery of the first subfossil Dodo material

The paucity of Dodo remains in the early 19th century led some authorities to doubt that the Dodo had ever existed, placing it among the make-believe creatures of myth and fantasy (Hume 2006; Nowak-Kemp & Hume 2016). This initiated a race to find the first subfossil remains, primarily led by the leading British scientists of the day (Hume and others 2009). Meanwhile, amateur natural historians based on Mauritius searched diligently for subfossil remains without success until a Dr Philip Ayres discovered a supposed Dodo bone in a cave in the Roches Noires district prior to 1860 (Cheke & Hume 2008), but its identification remains in doubt (JPH pers. obs). In 1865, George Clarke, a schoolteacher in Mauritius, who had also been searching for Dodo remains for many years, was informed by a railway engineer, Harry Higginson, about the retrieval of large numbers of bones of extinct tortoises from a marsh called Mare aux Songes in the south-east of the island (Hume and others 2009). A railway embankment had been constructed alongside the marsh, and labourers were stockpiling bones as they dug the marsh for peat. Clark sent some of the labourers into the centre of the marsh and a large number of Dodo bones were recovered (Clark 1866), though these were removed without contextual data. Such was the number of subfossil remains subsequently retrieved that almost all Dodo remains held in the world's museums today are derived from this one site (Hume and others 2009).

Although a number of 'complete' skeletons have been constructed from this material, the fossil deposit represents a composite of different Dodos; thus associated bones from a single individual are lacking. Tannins from decaying vegetation have stained the bones brown and black, though this has not affected preservation (Meijer and others 2012). Although these bones are relatively well preserved, determining how the individuals died and why so many Dodo remains have

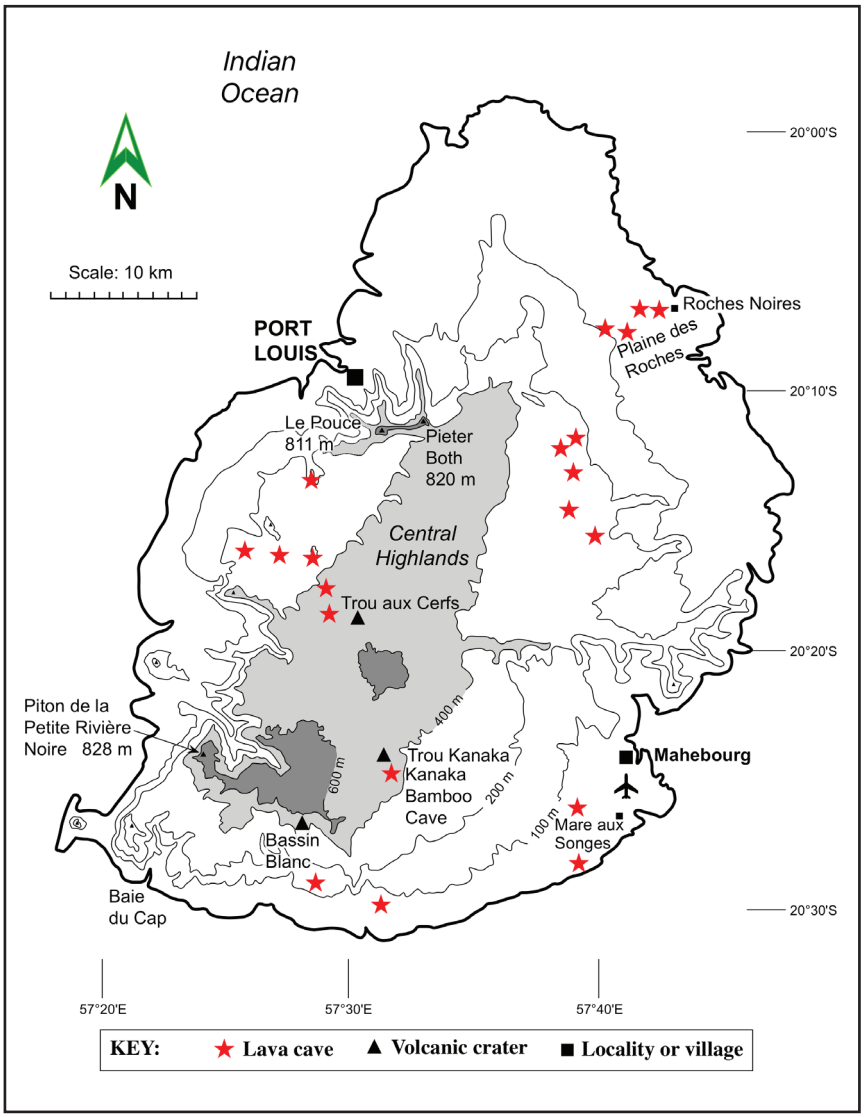

Figure 2. The island of Mauritius showing location of some lava caves and places mentioned in the text.

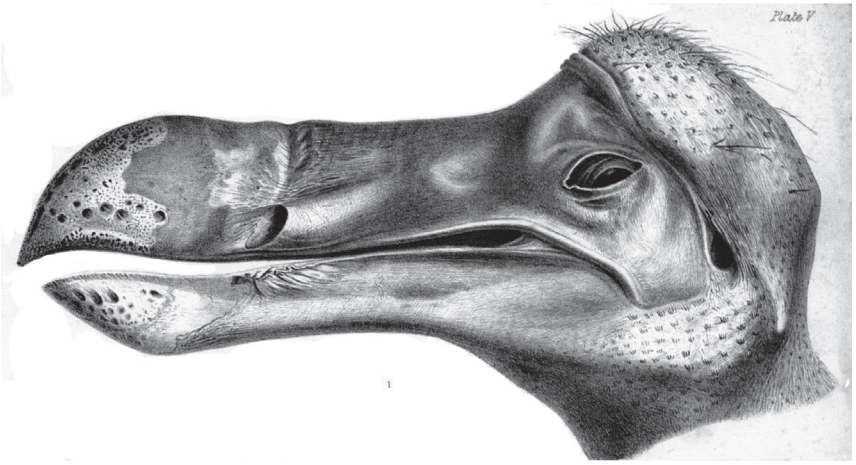

Figure 3. The only surviving head of a Dodo – the "Oxford skull" – from Fuller (2002, p. 114) as reproduced from Strickland & Melville (1848).

Figure 4. The only (nearly) single-individual Dodo skeleton – about 75 cm tall. (A few elements were provided from Mare aux Songes material.)

Collected by Thirioux in the early 20th Cent. and still on display in the Mauritius Institute.
(from Grihault 2005)

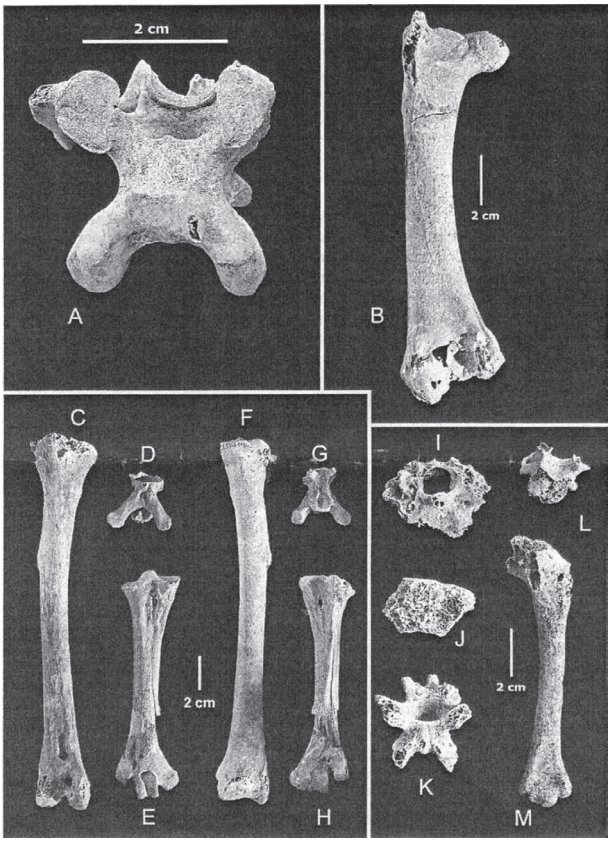

Figure 5. A-H Dodo bones from "small cave shelters" at Baie du Cap in southern coastal Mauritius; I-M from Plaine des Roches lava tunnels – as figured by Janoo (2005).

been preserved in the deposit has proved difficult. The thermal and chemical conditions in the swamp have also destroyed all DNA (Beth Shapiro pers. comm. 2007).

Around the late 19th/early 20th century, a barber and amateur natural historian, Etienne Thirioux, discovered a unique associated individual Dodo in an unspecified 'cave' location on Le Pouce, the third highest mountain of Mauritius (Hume 2007; Claessens & Hume 2015). This almost complete skeleton is extremely well preserved, and remains on display in the Mauritius Institute, Port Louis (Fig. 4). Unfortunately, Thirioux left no documentation as to the whereabouts of his discovery or any contextual data about its retrieval (Claessens & Hume 2015). However, recent examination of Le Pouce by the authors and zoologist, Owen Griffiths, revealed no lava tube caves but did identify a previously excavated boulder scree cave, which may represent one of Thirioux's collecting localities (Hume 2011).

Two other small collections of Dodo bones from lava caves have been reported (Janoo 2005). Five bones from lava rockshelters at Baie du Cap (Fig. 5 A-H) may have been deposited during the period of Dutch occupation after consumption by escaped slaves as they bear knife cut marks (Chowdhury 2003), and two bones and three fragments from a lava tube at Plaine des Roches (Fig. 5 I-M) are probably from natural accumulation. Up to 2006, the discovery of an associated individual Dodo with contextual data still eluded science.

The finding of subfossil Dodo Fred

In September 2006, while Middleton was assisting Dr Fred Stone and Deborah Ward, cave biologists from Hawaii, to search for cave cockroaches (Blattodea) in Mauritian caves, Ward happened upon some bones in a lower breakdown chamber in Kanaka Bamboo Cave, K1, in the south of the island (Middleton 2008) (Fig. 6). As they appeared to be old and fragile, Ward suspected they might be bones of the Dodo. Both biologists had previous experience with bird palaeontologists recovering subfossil bones from lava caves in Hawaii, and so were certain they were bird bones of great age. *In-situ* photos of the specimens were taken by Ward and these were forwarded by Griffiths to a colleague at the Natural History Museum, London, (JPH), who has made a long term study of the extinct fauna of the Mascarene Islands. Hume did not hesitate in pronouncing these bones as Dodo and excitingly responded to Griffiths: "This is only the second associated Dodo skeleton and the first with context" (Hume pers. comm. – e-mail to Owen Griffiths 15 Oct. 2006).

Subsequently the original party members took Griffiths to see the bones and to photographically record

the site (Figs 7, 8, 9, 10) after which it was agreed that the discovery should not be publicised until a professional team could be organised to collect it.

Some of the original photos of the bones had been captioned by Ward as "Dodo – Fred", referring to photos by Fred Stone of the dodo bones. After receiving the images, Hume casually called the skeleton Dodo Fred as a means of identification, thus the wrong 'affectionate' name, Fred, was applied to the specimen. The name has now become ingrained in the literature.

Hume and Dr Lorna Steel, a bone histology expert from the Natural History Museum, London, went to Mauritius in June 2007 to assist Mauritian authorities to recover the bones of 'Fred'. This occurred on 29 June, in the presence of the Mauritian Minister for Foreign Affairs, officials of the National Heritage Trust and TV camera crews. All contextual data was retrieved and the bones were chemically hardened to prevent damage (Figs 11, 12), before being transported to the Mauritius Institute, Port Louis, where they are now stored.

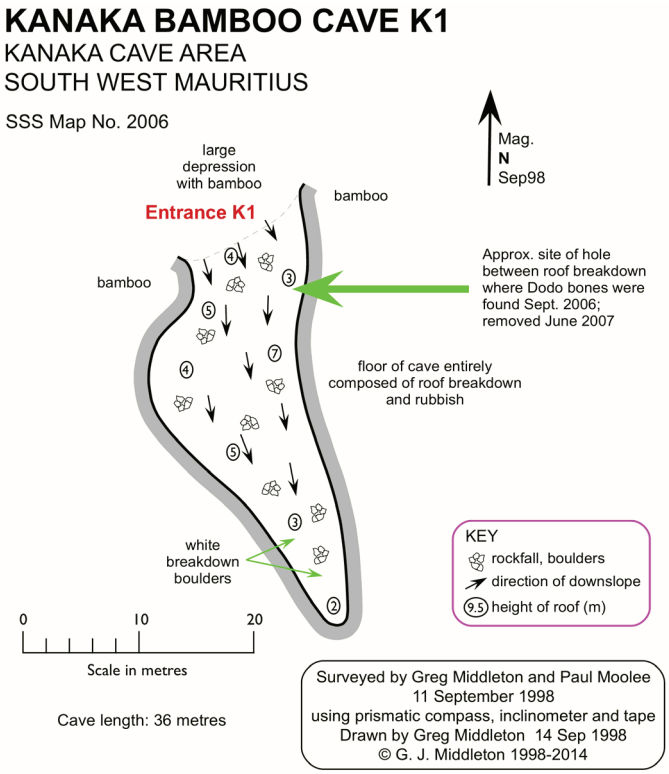

Figure 6. Plan of Kanaka Bamboo Cave.
The general area of the lower chamber in breakdown where Deborah Ward found the Dodo bones is indicated.

Figure 7. Dr Fred Stone and Deborah Ward at the entrance to Kanaka Bamboo Cave.

Figure 8. Deborah points to the depression in the floor where the skeletal material lies.

Figure 9. Large leg bones of the Dodo.

Figure 10. The main mass of skeletal remains – in an advanced state of decomposition.

Figure 12 (above). The bones of one foot were able to be recovered virtually complete. Photo (and preparation): Lorna Steel.

Figure 11 (left). Some of the bones immediately after removal from the cave. Photo: Lorna Steel.

The significance of Dodo Fred

After Dodo Fred's discovery, a number of reports were made about the importance of the find, but without realising the poor state of bone preservation, and before the presence of DNA could be established. On 3 July 2006 the *National Geographic News* reported:

Adventurers exploring a cave on an island in the Indian Ocean have discovered the most complete and well-preserved dodo skeleton ever found, scientists reported yesterday.

Very little has been known about the dodo—from what exactly it looked like to what it ate—since it became extinct in the 1600s.

The new skeleton is thought to be complete and was likely preserved by its cave setting.

Nicknamed Fred after the caver who found the bones, the bird was kept under guard while the recovery took place, according to press reports.

... the location of the new skeleton makes it much more likely to yield DNA, said Beth Shapiro, a geneticist from Oxford University who studies dodo remains. Most other dodo bones have come from a swampy region of Mauritius known as Mare aux Songes, she said.

"We have found tons of bones there, but the hot, wet, acidic environment has meant that the DNA survival has been terrible," Shapiro said.

The cave site of the new skeleton is likely to provide the best hope of a decent DNA sample because the bones will not have been exposed to sunlight and the temperature was fairly constant, she added. (Ravilious 2007).

Reflecting on the discovery in the initial stages, Hume wrote:

Not only did the bones turn out to be Dodo, they also belonged to a single individual in its position of death, a unique discovery [Fig. 13]. *The Dodo skeleton - affectionately called 'Dodo Fred' – was carefully removed, but many elements had already crumbled. However, these fragments are potentially suitable for DNA studies (unlike the material recovered from the Mare aux Songes), making Fred the most scientifically important Dodo in the World* (Cheke & Hume 2008).

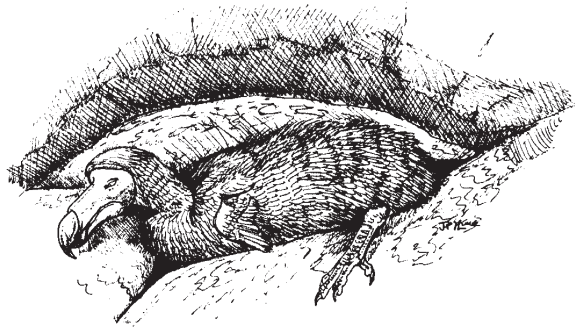

Figure 13. "Trapped in a cave and too weak to move, Dodo Fred died and his body collapsed into a small crevice, leaving part of the bill and one foot on the surface." Graphical interpretation of Fred's death by Julian Pender Hume (Cheke & Hume 2008).

Unfortunately, subsequent reports from the Natural History Museum indicated that tests on the Kanaka Bamboo Cave subfossils showed that collagen has not survived, in which case the DNA has also been lost (Lorna Steel pers. comm.).

Nevertheless, these bones are certainly important because they are from a single individual (only the second known) and they extend the known range of the species into the cool, damp highlands of Mauritius. While they are not destined to contribute to ongoing investigations into the phylogeny of the genus *Raphus*, the find has sparked renewed interest in this iconic species.

Preservation of bones in lava caves

In general, volcanic islands are notorious for the poor preservation and long-term survival of fossils in montane environments, primarily due to chemical decomposition and for topographical reasons, e.g. steep slopes leading to rapid run-off and lack of depositional basins (Hume 2005). Therefore the discovery of "Dodo Fred" in the highlands was unexpected. In the damp, humid cave environment where the specimen was discovered and coupled with an acidic environment – pH is always low unless carbonates are present – conditions are not conducive to bone preservation. The bones get leached very quickly of their organic content, leaving only the mineral structure, and become brittle (Hume 2005). This has resulted in a relative scarcity of subfossil bone material in lava caves on Mauritius. Furthermore, in Caverne de la Tortue, a lava tube cave in vesicular basaltic lava on Réunion, the cave atmosphere is extremely humid and the preservation of bone material is generally very poor. Recent remains of Hare (*Lepus* sp.), although dating from no earlier than c. 1850 (when hares were first introduced), were extremely fragile and disintegrated when being handled. Scanning electron microscopy of the hare bone surface indicated that not only was chemical degradation in process, but fungal hyphae and bacterial micro-biodegradation also played a major part in structural breakdown (Hume 2005). Large numbers of remains have been collected from calcarenite caves, such as those on Rodrigues (Hume 2013), but calcarenite caves are rare on Mauritius. In these limestone caves, subfossil bones can be found at depth or on the surface, and are not subject to the same chemical erosion as in acidic caves. Scavenging and disarticulation by vertebrates (mammals, birds, reptiles and amphibians), invertebrates (insects, snails, crabs) is prevalent but the bones themselves remain comparatively intact. Micro-biodegradation also occurs on exposed specimens but again significant loss of the bone structure is infrequent.

In complete contrast, bones collected from the Mare aux Songes are comparatively well preserved. Recent work by a Dutch-Anglo team (Rijsdijk and others 2009) has shown that the marsh, which otherwise would have a low pH, has a neutral to slightly alkaline pH value, therefore producing a stable chemical environment in which bone is perfectly preserved. The pH neutrality has been achieved by wind-blown carbonate sand entering the marsh, buffering the effects of an otherwise acidic environment. This factor and presumably rapid burial, which would reduce the effects of bioerosion and scavenging, provided an ideal environment for bone preservation.

In other fossil localities, significant and well preserved subfossil vertebrate deposits have been found in lava caves. For example in Hawaii, James and others (1987) were able to date bones weighing as little as 450 mg recovered from sediment in Puu Naio Cave on Maui which ^{14}C showed to be up to 7750 years old. In Haystack Cave, a small lava tube cave in Colorado, USA, a large collection of vertebrate remains were recovered dated at between 14,935 and 12,154 yrs BP (Emslie 1986). Steadman (1981) collected subfossil vertebrate remains from lava tube caves on the larger Galapagos Islands (Santa Cruz, Floreana and Isabela) where he noted that recent specimens were 'fresh and unmineralised' while older bones were 'dark and mineralised'. In none of the above examples which included bird material were the bones reported to be decomposing or even fragile, despite some being thousands of years old. However, bones of several individuals of two species of flightless rails (*Porzana* sp.) and much of the skeleton of a flightless ibis (*Apteribis* sp.) were collected from a lava tube in East Maui, Hawaiian Islands. Commenting on this discovery, Olson & James (1982, p. 15) noted that "The specimens were quite friable and deteriorated. They are probably of late Holocene age, as in the humid environment of a lava tube such as this one, exposed bone eventually disintegrates completely." Further, Steadman and Pregill (2004) reported "Samoan lava tubes are poorly suited for bone deposition and preservation because of flowing water, wet soils and stagnant air saturated with humidity." When they did find a bone deposit, they noted that the site was dry.

Why, then, were many of the bones of Dodo Fred reduced to fragments, or at least to fragile, weakened structures, when they might only be 300 years old?

It appears that a combination of factors is responsible. The depositional conditions of dry caves, even with high humidity, appear to have less effect on bone than those permanently wet, in which bone decomposition is comparatively rapid. Immediate burial is also important as it reduces the action of micro-bioerosion, but it is not essential as Rodrigues cave material will testify. Neither is altitude a pre-requisite for good preservation, as cave fossil deposits from montane regions have been perfectly preserved. Compared to marsh environments, cave deposits provide better opportunities for associated and articulated specimens, particularly if access is difficult, by reducing the effects of scavenging. Therefore high humidity coupled with permanent damp conditions as typified by Kanaka Bamboo Cave in which Dodo Fred was discovered, facilitates the detrimental actions of

chemical and biological agents. In the case of Dodo Fred, the organic component of the bones has been leached out leaving only the fragile mineral structure behind. How long the remains of this bird were lying in the cave cannot be determined, but in such an environment it is extraordinary that the bones of Dodo Fred survived at all.

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The 1830 Cave Diaries of Thomas Livingstone Mitchell

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Abstract

In 1830 the Surveyor-General of NSW, Thomas (later Sir) Mitchell gathered bones at Wellington and other cave sites in the NSW Central West, initiating almost two centuries of palaeontological research. This paper transcribes his previously unpublished diaries for the key 16 days of this essentially 'private' expedition to Molong, Borenore, Wellington and beyond, during which he spent 13 days in cave exploration and several more drawing cave maps and sketches. Mitchell's background, motivation and outcomes are discussed along with the contributions of some minor players.

Key words: Sir Thomas Mitchell; Wellington Caves; Molong; Borenore; expeditions

Introduction

The four official expeditions led by Thomas Mitchell into the interior of eastern Australia took place between 1831 and 1846. In recognition of the first three expeditions, his meticulous trigonometrical survey and 1834 map of the colony, he was knighted by Queen Victoria in 1839 (Figure 1).

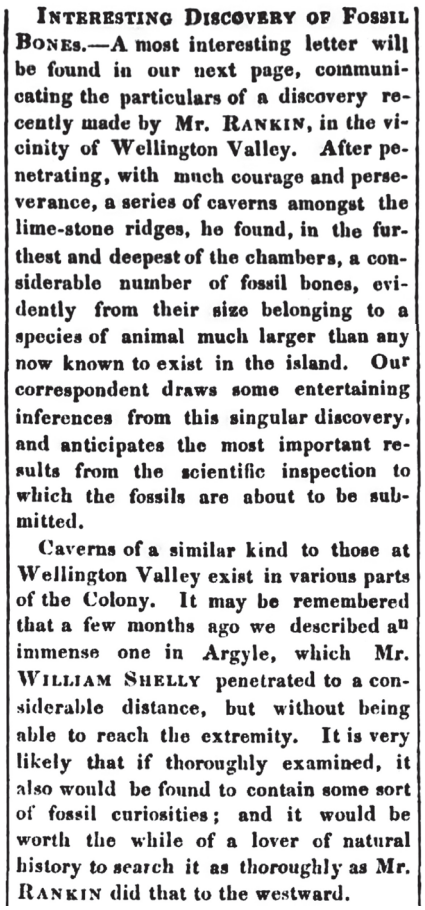
Over nearly two centuries, numerous publications, including some biographies, have reported the results of Mitchell's investigations at Wellington Caves in 1830 (Foster 1936, Lane & Richards 1963, Augee 1986, Osborne 1991, Branagan 1992). This is ground well-ploughed over and under, but much less has been conveyed about the conduct of the actual 1830 'expedition' itself, mounted less than three years after his appointment as Surveyor-General of NSW. Overshadowed both by the four major exploratory expeditions and by the saga of the bones, Mitchell's own journals for that period have remained unpublished. This paper transcribes the complete unpublished diaries of his remarkable 1830 speleological excursion from Bathurst to Wellington and return, and discusses the context in which it was conducted.

Figure 1. Portrait of Sir Thomas Mitchell, c. 1830s (State Library of New South Wales ML 24)

Mitchell's motivation, means and movements

Possibly inspired by Buckland's 1824 book attributing animal bones in caves to the Great Flood, Mitchell made the acquaintance in London of both Buckland and his colleague W.H. Fitton, and on their proposal he joined the Geological Society in April 1827, seeking instruction, mentoring and advice from them and other experts. Arriving in Sydney on 23 September 1827 he soon established an interest in searching for bones in Australian caves, exploring Grill Cave at Bungonia in December 1829, but found no bones. Then on 25 May 1830 the *Sydney Gazette and New South Wales Advertiser* alerted its readers to the large, recently-discovered cave (i.e. Grill Cave) in County Argyle that could contain *"some sort of fossil curiosities"* (Figure 2). The same issue published a letter signed 'L' (attributed to J.D. Lang, 1830) reporting discovery of large fossil bones in caves in the Wellington Valley, which *"will doubtless excite much interest among the geologists of Great Britain ... in regard to the geological history of this vast island"*.

Within three days of this announcement Major Mitchell left Sydney, his ostensible aim being to examine and direct progress on construction of the Great West Road to Bathurst in his role as Surveyor-General. This he did en-route, liaising with and instructing his assistant surveyors and military colleagues in charge of convict gangs. His remit did not however extend further. Nevertheless, of the 65 days until he returned to Sydney, travelling through little-known and almost



INTERESTING DISCOVERY OF FOSSIL BONES.—A most interesting letter will be found in our next page, communicating the particulars of a discovery recently made by Mr. RANKIN, in the vicinity of Wellington Valley. After penetrating, with much courage and perseverance, a series of caverns amongst the lime-stone ridges, he found, in the furthest and deepest of the chambers, a considerable number of fossil bones, evidently from their size belonging to a species of animal much larger than any now known to exist in the island. Our correspondent draws some entertaining inferences from this singular discovery, and anticipates the most important results from the scientific inspection to which the fossils are about to be submitted.

Caverns of a similar kind to those at Wellington Valley exist in various parts of the Colony. It may be remembered that a few months ago we described an immense one in Argyle, which Mr. WILLIAM SHELLY penetrated to a considerable distance, but without being able to reach the extremity. It is very likely that if thoroughly examined, it also would be found to contain some sort of fossil curiosities; and it would be worth the while of a lover of natural history to search it as thoroughly as Mr. RANKIN did that to the westward.

Figure 2. Extract from the *Sydney Gazette and New South Wales Advertiser*, 25 May 1830 (Trove, National Library of Australia)

unsettled country beyond Bathurst, he was engaged in speleological activity on 20 days – discovering, exploring, surveying, sketching and drawing up maps.

Wellington was at the very frontier of white settlement, the first settlement having occurred only seven years earlier, ten years after the first crossing of the Blue Mountains by colonials. No land grants or selections were authorised beyond. On his remarkable private excursion Mitchell explored, diarised and sketched caves at Wellington, Molong and Boree (Borenore), and visited sites nearby – probably at Burran Burran and Geurie. In 1836 the outcome of the investigations at Wellington Caves appeared as one chapter in his well-known account in *Three Expeditions into Eastern Australia* (Mitchell 1838). Numerous subsequent accounts have appeared, the most accessible of primarily speleological interest being Lane and Richards (1963). However most biographies omit mention of the extensive diaries of this remarkable exploit, although in his historical summary Foster (1936) did reproduce one key date's explorations. Dunkley (2009) focused on the significance of the back-stage, somewhat asymmetrical rivalry in 1830 between Mitchell and John Henderson (1832). Osborne's (1991) history of the red earth and bones acknowledged Henderson and highlighted the significance of Mitchell's observations of the sediments, while Oldroyd (2007) assessed Mitchell's geological contributions more comprehensively.

The journal and the journey

Mitchell's 65-day journey can be divided into four phases: 26 days to Bathurst, 16 more to Wellington and return via Molong and Boree, then 14 days camped at Bathurst (during eight of which he was engaged in drawing up the cave maps) and 8-10 days to return to the Weatherboard Inn (Wentworth Falls) and Sydney (Mitchell 1830a). This paper focuses on phases 2 and 3.

In the present transcription for the Bathurst–Wellington return phase of the expedition (see Appendix) original diary dates are retained along with variations in the way they are recorded. He left his property, "Craigend" in Darlinghurst, Sydney at 1 pm on Friday 29 May, 1830 (Figure 3). However this journal date is clearly incorrect as elucidated by Dunkley (2009): Friday was the 28th. He seems to have thus left on a Friday, certainly met the Governor on the following Sunday, filled the diary for every day until his return to Sydney, but appears not to have corrected the error in dates until he arrived back in Bathurst 43 days later, when he made two entries, for both Friday 10 July, and Saturday 10 July (Figure 4). Consequently the dates in his diary up to that day, including all the cave visit dates, should be retarded by one day. For someone so meticulous in his surveying it is curious that he wasn't corrected by anyone on his travels! At a time when Sundays were sacrosanct, actual dates of the month probably pressed somewhat less on the daily routine of remote settlements.

Mitchell paid a courtesy call on Ralph Darling at Government House Parramatta, paused for two nights at the Weatherboard Inn at Wentworth Falls (long enough for a side-trip to the falls themselves), then crossed the mountains to Hartley Vale. On the forward journey most time was spent in mobile camps: planning, marking out, surveying and issuing instructions for a new route (now Victoria Pass) from Mt Victoria to Hartley, then across the Lett and Coxs Rivers, past the future site of Lithgow, and on to Bathurst.

Spanning 16 days, the second phase chronicles 13 days of whirlwind speleological activity at least partly in caves, 11 of them successive. After a day and a half riding from Bathurst on George Ranken's gig, he stopped overnight in a soldier's hut at Molong and briefly explored his first cave in the district. Nine days were based at Wellington, of which six were spent extracting earth-coated bones from the Large or Big (i.e. Cathedral), Breccia (Mitchell) and Bone Caves – exploring, digging, surveying and sketching. Setting out early, a long first day (26 June) was spent in the caves, returning *"very tired"*. Next day he followed up a report about a more distant cave, finally locating it at 2 pm the following day: *"this day we rode at least 45 miles without great advantage"*. Unsurprisingly, on the third day *"we were all rather tired this morning"* but in the afternoon they went caving again. Returning yet again on the following

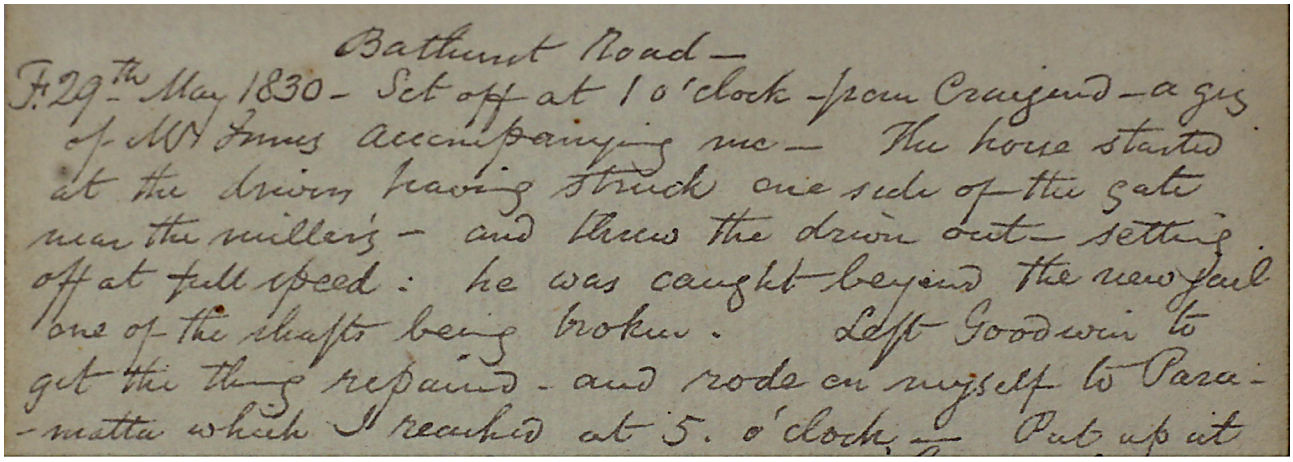

Bathurst Road—
F. 29th May 1830— Set off at 10 o'clock from Craigend—a gig of Mr Innes accompanying me— The horse started at the drivers having struck one side of the gate near the miller's— and threw the driver out— setting off at full speed: he was caught beyond the new fault one of the shafts being broken. Left Goodwin to get the thing repaired— and rode on myself to Parramatta which I reached at 5. o'clock— Put up at

Figure 3. Mitchell's diary entry with incorrect departure date, Friday 29 May, 1830.
(Mitchell Library, State Library of NSW C42)

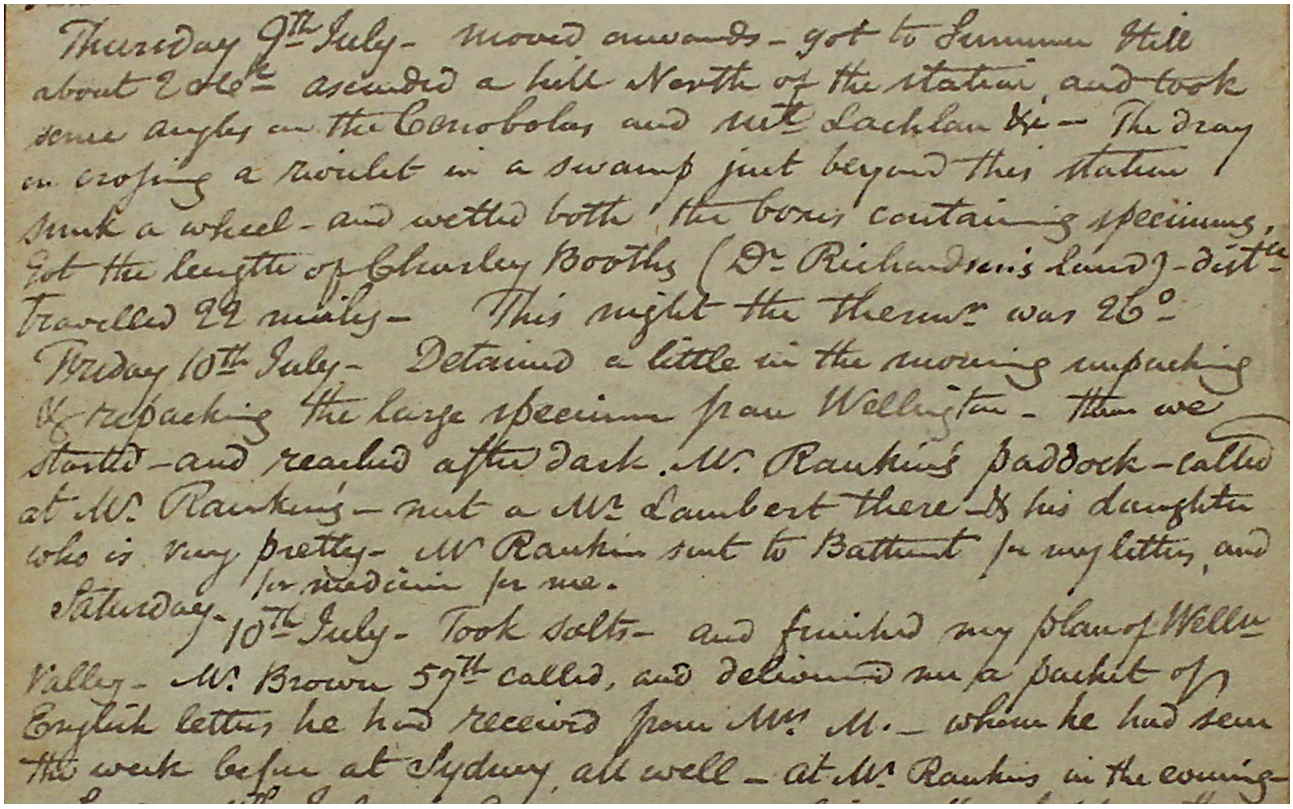

Thursday 9th July— moved onwards— got to Summun Hill about 2 oc— ascended a hill North of the station and took some angles on the Canobolas and Mt Lachlan &c— The dray on crossing a rivulet in a swamp just beyond this station sunk a wheel— and wetted both the boxes containing specimens, Got the length of Charley Booths (Dr Richardson's land)— distce travelled 22 miles— This night the thermr was 26°—
Friday 10th July— Detained a little in the morning unpacking & repacking the large specimen from Wellington— then we started— and reached after dark Mr Rankins paddock— called at Mr Rankins— met a Mr Lambert there & his daughter who is very pretty— Mr Rankin sent to Bathurst for my letters, and for medicine for me.
Saturday 10th July— Took salts— and finished my plan of Wellington Valley— Mr Brown 57th called, and delivered me a packet of English letters he had received from Mrs M.— whom he had seen the week before at Sydney all well— at Mr Rankins in the coming—

Figure 4. The two entries for 10th July, 1830 on his return to Bathurst, when he reverted to correct dates.
(Mitchell Library, State Library of NSW C42)

day (Monday 29th) he surveyed the large (i.e. Cathedral) cave, sketched its gallery and The Altar, and later surveyed (probably on the surface) a line connecting the entrances of what we now call Cathedral Cave and the Bone Cave. More caving and horse-riding followed: overall three days were spent taking theodolite angles, possibly to justify his 16 days absence from official duties, but he still managed to enter caves on almost every day.

Returning to Molong he diverted to Boree in Ranken's gig for a day's caving; this clearly stretched to a second day as a Mr Oliver, the overseer at Boree Government Station six miles to the west, was sent back to obtain some provisions and a kangaroo cloak, under which Mitchell spent a *"tolerable night"*. Returning to Molong next day he made another visit to the cave entered briefly on 24 June, 500 yards west of his campsite by the river. Finally reaching Bathurst, eight of the 14 days of phase 3 were spent drawing up cave maps and sketches. The return journey east across the mountains took the final 8-10 days.

Surveying and sketching equipment

Travelling mainly on horseback and accompanied by a small servant retinue including a dray carrying equipment, tent and home comforts, Mitchell himself

often marked out the westward route on trees, relying on overseers and convict labourers to then clear ground for the new road. A Gunter chain (one 'chain' or 66 feet long – about 20 m) divided into 100 links of thick iron wire was laid out by convict chain-men and usually supervised by an assistant surveyor. A circumferentor was carried to more rugged high points. Used with a chain when traversing, this instrument provided a relatively quick method of measuring horizontal directions in surveying, but lacked the accuracy of a theodolite, and would have been used for the survey of the Bone, Cathedral and Breccia Caves. A prismatic or azimuth compass (possibly similar to that invented by Kater in 1811) may have aided his observations due to its portability. Similar cave surveying instruments – metal tape, forestry and prismatic compass – were largely unchanged until barely 20 years ago.

It seems likely that the sketches made at Wellington and completed afterwards in Bathurst were aided by a camera lucida, an instrument similar to the older camera obscura but lighter, more portable and less demanding of special lighting conditions. Early designs produced an image both inverted and right-left reversed, but a version patented in 1807 used a prism with four optical faces to produce two successive reflections, thus producing an image that is not inverted or reversed. During his return to Sydney, Mitchell mentioned (1 August) using a camera lucida to sketch the rock (still half-demolished) at Victoria Pass. Similar instruments are still used by modern artists, and computer photo-editing software now provides functionality. His camera lucida (Figure 5) is lodged with the Royal Geographical Society of Queensland which also possesses the paintbox with which the sketches were enhanced.

The difficulties of survey work in the Australian bush in the early nineteenth century can hardly be overestimated. Mitchell's surveyors usually ventured into

Figure 5. Mitchell's camera lucida. (courtesy Royal Geographical Society of Queensland)

almost unexplored country for a month or more, worked to a frazzle with a team of convicts, drays carrying tents, survey equipment and provisions, and with draft maps typically returned to a dressing-down from Mitchell and a litany of complaints about a parsimonious Survey Department.

Mitchell's Megafauna Mates

Several offstage players informed, influenced and assisted the conduct of Mitchell's expedition to Wellington, giving us insight into the energy, determination and curiosity of some early settlers. Local Aborigines are mentioned favourably in places and certainly guided him to some locations. Buckland, Fitton and the Geological Society members each provided intelligence and training on matters geological, palaeontological and perhaps theological, considering Buckland's belief in the Universal Deluge or Great Flood.

John Dunmore Lang first published reports of cave bones in NSW using the nom-de-plume 'L', probably following information from George Ranken ('L' 1830). The first Presbyterian minister in the colony and a close colleague of Mitchell with independent means, he apparently accompanied the bones in 1830 on one of his several return voyages to Britain. Lang also carried Mitchell's manuscript to the home country, communicating the news to the *Edinburgh New Philosophical Journal* which erroneously attributed Mitchell's actual report to Lang, correcting it in the following issue (Lang 1831a, 1831b). As a Calvinist churchman Lang supported belief in a Universal Deluge which was at the time being queried, and probably did not wish to be involved in debate about Divine Creation, evolution or the antiquity of bones. Outspoken, censorious and wowserish, he evolved as a writer, newspaper proprietor, politician and strong advocate for immigration, education and a republic.

George Ranken (correct spelling, not Rankin as in the diaries and perpetuated in the named street in Bathurst) first disclosed the cave discoveries. Although these had been known a few years earlier by local settlers and, for example, explorer Charles Sturt in 1828, he brought some bones to Sydney and possibly apprised Lang. A wealthy property owner, he was also a bank director in Bathurst and a magistrate whose territory extended to Wellington. He owned a coach which probably conveyed Mitchell during his time in Bathurst (Figure 6). Ranken appears on-stage as an energetic fixit man and continuing later correspondent (see below). In a later letter to Ranken on 24 July 1833 Mitchell stated that *"Buckland's nose is put completely out of joint by the bones from Australia"* and that this had provoked much learned speculation in England.

John Henderson was an accomplished, well-educated surgeon and somewhat ascetic traveller who founded

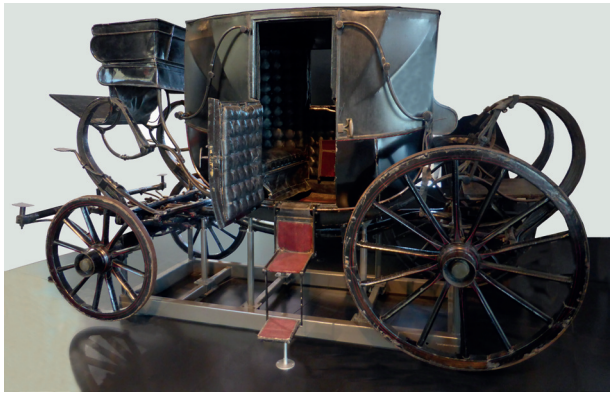


Figure 6. Now housed at the National Museum of Australia in Canberra, George Ranken's coach probably occasionally conveyed Mitchell during his time in Bathurst; he also rode more widely in Ranken's gig. (Author, 2016)

Australia's first scientific society in Hobart (Hoare 1968). He and Mitchell both grasped the significance of the *Sydney Gazette*'s account of megafaunal cave fossils, both had access to Governor Darling, both swiftly set out for Wellington and were whirlwinds of activity. They must surely have met earlier, or at least known beforehand of the existence of each other. However the only firm evidence of their ever meeting is Mitchell's disparaging diary entry at Molong, Monday 6 July, after which Henderson continued with James Walker towards Wellington, where on his own account he did collect some bones and report back to Darling. What happened to those bones is unknown. He and Mitchell thus visited the caves just a few days apart. Trenchantly critical of the Surveyor-General's administration, Henderson's 1832 book is his legacy, but neither he nor Mitchell ever acknowledged each other in their respective publications. His report is misleadingly dated 1 July, by which date he had not even reached Wellington; his role in the saga is discussed more fully in Dunkley (2009).

Ralph Darling, as Governor of NSW, was also critical of Mitchell's tardiness (even neglect due to his other passions) on aspects of the surveying work. Aware of Henderson's background and using him as a foil against the Surveyor-General, he probably conveyed that sentiment when Henderson sought support. Mitchell's diary records a courtesy visit to the Governor *en route* to Bathurst, but only inferentially of an intention to continue to Wellington which was essentially a private excursion. However Darling undoubtedly knew, and probably gave more than tacit encouragement to Henderson's excursion. Darling and Mitchell never got along and within a year the Governor was recalled to London.

James Kinghorn (sometimes with an 'e' as in the diaries) was Superintendent of Emu Plains Convict Farm 1826-1829 (preceded by his father Alexander), then appointed Superintendent of the Wellington Valley Settlement until it was closed a year or so later. Sometimes in the company of George Ranken, he discovered and explored several caves before Mitchell's arrival. He conducted Mitchell into Wellington on 25 June, accommodated him at the settlement, provided the boxes to carry the more than 1,000 bones, and accompanied him on cave exploration. The government closed the Wellington Valley settlement shortly afterward and Kinghorn received land grants (apparently in the Murrumbidgee Pastoral District). Presumed descendants owned a shop in Wellington (Kinghorn & Co.) until about 1900, but were not listed in the 1909 telephone directory.

James Walker owned property in Parramatta, Hartley and Bathurst and was well known to Ranken and Kinghorn as a fellow magistrate. He assisted with the exploration at Boree, extracted some bones from a crevice or cave there, accompanied Henderson to Wellington, then later again met Mitchell during the return to Sydney, assisting with minor surveying in early August. Mt Walker, 6 km west of Lithgow, commemorates his name.

Kenneth Snodgrass played no direct part in the saga but exchanged 11 letters with Mitchell during the 65 days. He later became Acting Governor between Bourke and Gipps. The links between Snodgrass, Mitchell and Darling have origins in their military service in the Peninsula War in Spain.

Surveyor John Rogers appears in the diary entry for the day Mitchell left Bathurst for Sydney, having been summoned there because at the time he rated very highly with Mitchell, who classed him as *'one of the serviceable surveyors of the Department'*. This was high praise from an extremely demanding, overbearing superior in disciplining his assistant surveyors, who suffered losing bullock teams while the drays laden with tents, survey equipment and provisions kept breaking down in rugged, often unexplored country. Rogers was assiduous in implementing instructions to locate and survey limestone and caves (Dunkley 2009).

After the Expedition

By 14 October 1830 Mitchell had written a lengthy report on his discoveries and forwarded it *"by the 'Gilmore', Captain Gearey, three large boxes of bones and a report (36 pages) with ten plans and drawings to the Geological Society..."* (letter, Mitchell to Ranken, December 1830, cited in Ranken 1916). The report was read at the Society's meeting in London on 13 April, 1831. The paper was formally submitted but for unknown reasons publication was refused and it appeared as an abstract only. This likely centred on the simmering learned debate about the implications of cave bones for the prevailing belief in a Universal Great Flood, it being barely seven years since publication of Buckland's book (Mitchell 1831, 1834a). Rebuffed, he incorporated it as a final chapter in his *Three Expeditions into Eastern Australia*, even though none of it related to the routes of those expeditions (Mitchell 1838).

The original of his sketch of the "Large Cavern at Wellington Valley" (i.e. Cathedral Cave, Figure 10) is apparently housed with the National Museum of Natural History in Paris. Befitting a cave surveyor, the maps were highly professional, and probably only the second produced in Australia. On the other hand Henderson had published his hasty amateurish sketches of both Wellington and Boree Caves some six years earlier, thereby providing Australia's earliest depictions of karst features.

On 24 July, the day he left Bathurst, Mitchell recalled Surveyor John Rogers from the Hunter River area and despatched him to Bathurst, Molong and Wellington with instructions, *inter alia*:

"*You will also note particularly where limestone occurs in all your Survey and this you will tint on your Map by a grey made by mixing blue and red together shewing something like the extent of limestone rock"* (Mitchell 1830b).

In September Rogers reported back:

"Having understood that you wish to know the native name of the caves, I have ascertained those near Boree to be called Mulwang, those near Wellington seem to be sounded Welbang, and others there above the junction of the Cudgegong called Werran-dang.

The natural troughs which I understand were empty when you visited the caves are now full of Water proceeding apparently from the concreted mass above" (Rogers 1830b).

In his own notebook Rogers (1930a) had related (9 September):

"Plotting – Sent two men to dig for Bones at the Caves near Wellington Valley NB informed that there are other and more extensive caves in the vicinity of Canobolas not yet visited by person collecting therefrom".

These more extensive caves on 'Boreenore Creek' had in fact already been cursorily examined by Mitchell on 5 and 6 July without great success. Although not part of Mitchell's new instructions, Rogers visited Boree again on 28 September, 30 November and 25 and 26 December 1830, while Mitchell himself returned for a more thorough search on 18 March 1836, on his great expedition to Australia Felix.

Based on Rogers' investigations, Ranken continued correspondence with Mitchell, conveying news of more cave discoveries at Boree, Mitchell replying on 17 January, 1831 to the effect that:

"I at first determined to be at Bathurst ... to explore them. On more mature consideration, however, I find that I cannot indulge myself so much at present ... thus I may find it necessary to go very soon as far as Bathurst, and then I should explore the caves at leisure."

Mitchell wrote again on 21 August, 1831:

"... Although I have been so lately near Bathurst, it is probable that I may very soon call on you there, with a view to visiting the caves again, and explore the new ones ... I know that everything depends on accurate descriptions of the caves, and the particular position in which specimens are found, I am much inclined to go myself ... pray let me know by return of post, and also whether you can send me some good specimens, as I have none left".

… and then again on 30 October:

"I much wish I could visit the bone caves again ... but I have many things to put in order before the new Governor's arrival. You will, I have no doubt, have heard from Dr Lang that I have now the Edinburgh Philosophical Journal *where I see honourable mention made of you, and a good deal about the bones . . . I am most anxious to explore now, and have some hopes of being sent. I have some thoughts of resigning, if I am not allowed, as I came out with a clear understanding that I should be so employed."*

But within a month of that date Mitchell's priorities changed dramatically. Authority for his first great expedition into new country had arrived, Wellington was in his past, and a new era of land exploration in Australia had opened. Fame and a knighthood awaited.

Much longer after the Expedition

Wellington Caves and, to a much lesser extent, Borenore have been well studied and documented. Speleologists have recorded 148 karst features at Wellington and at least 28 at Borenore (Boree), and sound management plans are in place.

Nearly two centuries after Mitchell, the other three areas, mostly on private tenements, are seldom visited. An inventory of the region's karst resources (Dunkley & Dykes 2000; Dykes 2001) recorded 81 features at Molong, 13 at Geurie and 5 at Burran Burran. Nearly all are little more than dolines and large grikes in agricultural land, and several appear to have been filled in. A number have suffered deterioration or even disappeared.

Burran Burran Cave has apparently been filled in, and it isn't certain just which one of the several limestone outcrops in the Geurie district was that visited by Mitchell on 27 June 1830. His diary places it as

"... a large cave to the Northward of the Macquarie . . . it turned out to be mainly a sinking of the earth . . . and of 30 ft descent, at the bottom of which was about 40 feet from the surface . . . but I was dissappointed [sic] to find no subterraneous passage to go further".

There is a low limestone hill very close to the target area, right beside the Wellington–Dunedoo Road,

Figure 7. Two modern light industrial buildings at the corner of Watson and Molong Streets, Molong, now seal the cave visited by Mitchell on 24 June and 8 July 1830. Molong residents and others report that the cave had at least two entrances. (Author, 2016)

however information from local landowners in 2016 suggested once again that the cave or depressions had been filled in years earlier.

At Molong four or five small caves are known and numerous karst features documented by Orange Speleological Society (Bruce Howlett pers. comm. 2016). The cave visited by Mitchell on the night of 24 June 1830 is most likely that now recorded as MO-1, located at the foot of a hill on the corner of Watson and Molong Streets, and now covered by cement floors on two light industrial sites (Figure 7). Arriving after dark, he wouldn't have had time for more than cursory inspection, but returning on 8 July he wrote that *"These small holes both communicate with the surface above"*. Molong residents and others report that the cave had at least two entrances and that on one occasion a fire at one entrance (a former service station clearly visible on Google StreetView) had emitted smoke from the other. Several other caves in the township suffered similar fates of destruction or filling. Intermittent cave exploration was reported at Molong in 1899, 1920, 1929, 1936, 1938 and 1948, along with occasional proposals for opening one to the public. One writer in 1936 suggested that a few plugs of dynamite would open the entrances to see if there is anything worth developing; another in 1938 expected that *"within a couple of weeks it* (another cave) *will be blown to pieces by a charge of dynamite and trucked to Sydney to make beer bottles"*.

Mitchell's legacy

Mitchell personally explored caves at Wellington, Molong, Borenore, Oakey Creek, Bungonia, Cheitmore, Big Hole, Glenelg River (Victoria) and probably Burran Burran and Geurie. With a passion bordering on obsession and mirrored by many enthusiasts of matters subterranean, his unspoken strategic plan is familiar to many speleological and research expeditioners, or just to those pursuing a complex caving project. A mixture of scientific training, clear objectives, skills honed by military experience fuelled his internalising of the 8 Ps – proper prior planning and preparation prevents piss-poor performance.

He explicitly instructed the assistant surveyors to search for limestone and caves and record them on survey maps e.g. Rogers 1830a, 1830b, Mitchell 1830b). Rogers himself located and assiduously mapped limestone at Molong, Cumnock, Bakers Swamp, Nubrigyn Creek, Burran Burran, Dripstone, Boduldura, possibly Stuart Town and Finchs Cave, and sites along the Macquarie and Cudgegong Rivers, some of the last in particular now being submerged beneath Burrendong Dam. Other assistant surveyors documented Taemas, Narrangullen, Wee Jasper, Coolemon, Goodradigbee, Lobs Hole, and Mudgee.

So, was Mitchell Australia's first speleologist or simply using caves as a means to an end? Later generations may legitimately debate whether in his ambition, vanity and prospects of glory, he was merely exploiting caves for their contents (Dunkley 2003). Nevertheless, it was pioneering work in a new colony claimed only 42 years earlier by white settlers, it spawned two centuries of research and was a remarkable achievement. At the time fewer than 40,000 white settlers and convicts lived in the entire continent – the first census was only two years earlier – with barely a thousand or two west of the Blue Mountains.

Mitchell, Henderson and lesser players deserve their place in the history of cave science in Australia. The travails and dedication of Mitchell's assistant surveyors such as Rogers, along with workmen and convicts were equally extraordinary; it was they who traversed unexplored country and first recorded so many new cave and limestone areas, and they whose perseverance contributed to Australia's most astounding early cartography (Mitchell 1834b). Their contribution, mostly previously unpublished, is ably celebrated in several recent specialist books by the late surveyor Alan E.J. Andrews (e.g. Andrews 1992). Spanning a period of little more than twelve months, there have arguably been few, if any, such intense, productive periods of cave documentation by one or two individuals, enabling Major Mitchell's inspirational legacy to dub him Australia's first speleologist.

Acknowledgments

Ever-willing staff of the State Library of NSW assisted greatly in preparation; their patience with temperamental old microfiche readers and printers (since superseded) was particularly appreciated. The Archives Office of NSW located and provided microfiche records of the notebooks of John Rogers and other assistant surveyors. The invaluable Trove facility of the National Library of Australia was its usual

mine of information. Bruce Howlett (data coordinator for Orange Speleological Society) assisted with field inspections at Molong, while Peter Dykes advised about the modern documentation system. Dr Michael Augee provided advice, accommodation and local contacts at Wellington, where Peter Sheridan also guided us to some sites. Bruce Welch produced scans of material, helped to source other illustrations, and was his usual fount of technical knowledge. Jeanette Dunkley was as patient as ever in proofreading. Friendly members of the Molong Historical Society contributed more local knowledge than could be fully encompassed in this paper.

APPENDIX: The Diaries

In the present transcription the original diary dates are retained along with variations in the way they are recorded. The handwriting is sometimes difficult to read and question marks (*?*) indicate doubtful rendition. Abbreviations, spelling and punctuation including variations evident in the original are also retained, but some diarised abbreviations in the form of superscripts have been transcribed to ordinary lower case. The old-fashioned double 's' letter appears frequently, along with the ampersand (&) which was widely treated at the time as a 27th letter of the English alphabet, sometimes appearing in the diaries lying partly sideways, sharing with "etc." the meaning "and so on" but written approximately as "&c". Further, it is difficult to distinguish between marks for a dash (–) and those for a comma, affecting the flow of sentences. Original spelling has been retained, for example the word 'diluvium' appears correctly in one place, in another as 'dilluvium'. Deletions are shown as in the original. Background comments and elucidation by the present editor are in italics.

Figures 8, 9, 10 and 11 are included with the Appendix for illustrative purposes.

Sydney to Bathurst

29 May to 22 June

Mitchell left his home, "Craigend" at Darlinghurst at 1 pm on the last Friday of May 1830 (see note above). After visiting the Governor in Parramatta on the Sunday and a two-night stay at the Weatherboard Inn at Wentworth Falls he encamped below Mt York to direct scouting, surveying, clearing and construction of a new road from Mt York to Bathurst, including a new route off Mt York (now Victoria Pass), exploring routes across the Lett & Coxs Rivers and establishing several camps between Hartley, Lithgow and Bathurst. After three days making arrangements in Bathurst, he and Ranken left for Summer Hill (near present-day Orange), Molong and Wellington.

Bathurst to Wellington and Return

Tuesday 23 June

Wrote Mr Everton enclosing plan of allotments & requesting him to give publicity to an arrangement of mine that the solutions should be *[words deleted in the original:* ~~related as they come in the Govrs~~*]* communicated by letter to me on or before Tuesday the 5th inst't. At length about 2 o'clock Mr Rankin & I set out in a gig for Wellington Valley, and reached that night, Charley Booth's, a hovel on Dr Richardson's farm dist't 24 miles. The dray following us on this tour and one pack-horse, the whole dray of luggage being left at Mr Rankin's, as well as the remaining packhorses, & Worthington – who being ill with boils, I directed to remain at Mr Rankin's & look after the horses. Raining.

Wednesday 24 June

A rainy morning. We started however and after a few hours reached Summer Hill station. We rested our horses a little. A very tidy Soldiers wife seemed to keep her hut very neat. The husband and comrade came in soon from Kangaroo hunting. We continued and in the evening reached Molong, a Gov't stock station 28 miles from Summer Hill, or 38 from Charley Booths. A Corp'l and private of the 39th were also stationed here and we passed the night in their hut. The Soldier Oliver – or Quin *[?]* having been once in the Buffs, and being now desirous of settling when his 20 years are out, was very obsequious to me. At Summer Hill this morning, one of the "specials" as they are termed, was pointed out to me, he had been a L't in the navy. I saw him in the rain with a Parramatta Jacket on & his cuffs turned up, feeding some pigs, there was another good looking young man. In the evening we explored a cave - (recent being).

Thursday 25th June

The morning rather rainy – it cleared up however very soon – we had a pleasant ride and were met, some miles from the Settlement by Mr Kinghorne who conducted us to Wellington Valley where a nice blazing fire in a rather handsome bowficated *[bifurcated?]* room was awaiting us, and we soon had a very comfortable dinner.

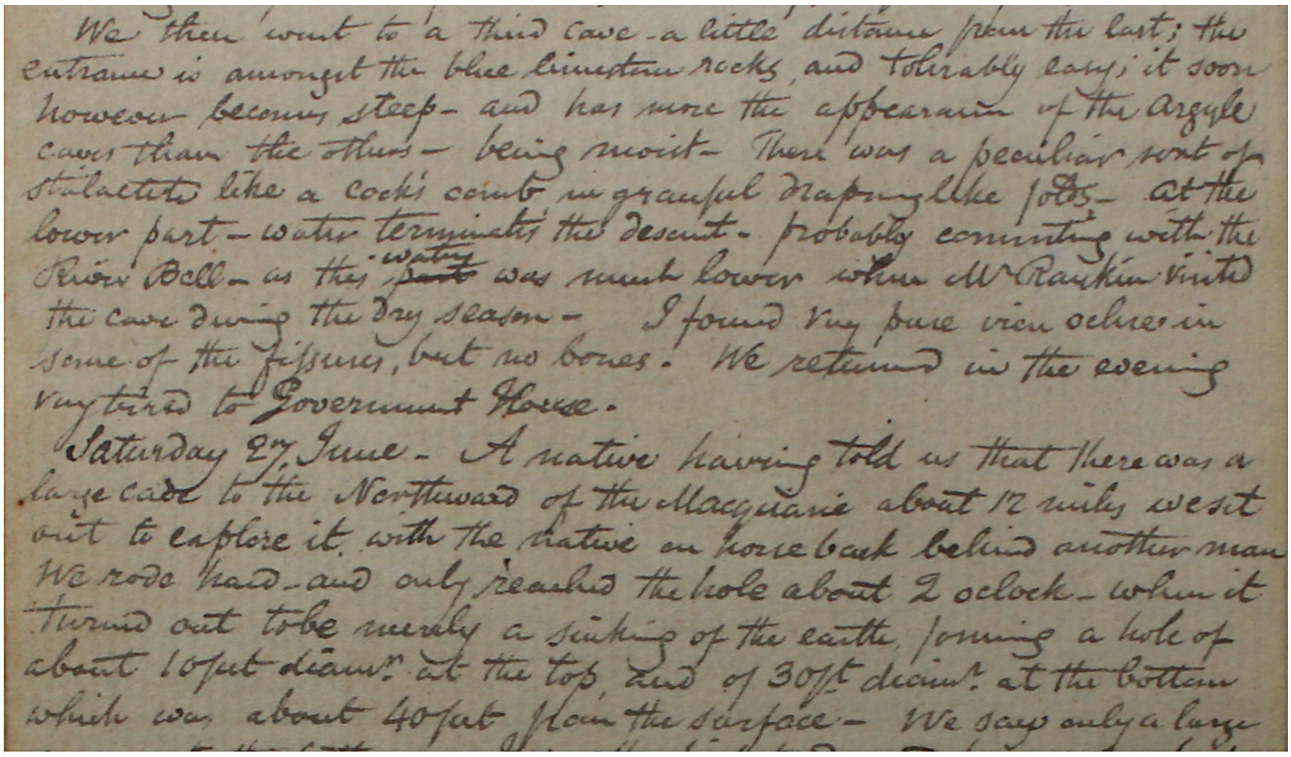
Friday 26th June

We set out altogether, rather early to examine the Caves. First Mr Rankin descended into one lately discovered by Mr Kinghorne but after some time he returned breathless and really knocked up; having been occupied the whole time with ascending and descending the narrow crevice just

Just *[word is repeated in original]* wide enough to admit his body. We then went to the great cave, the descent into which is easy, and I was astonished and

gratified at the grand and simple proportions of every part of this cave; first we enter after winding along a broad & lofty passage – the great gallery around the chapel where there is also the altar-steps, font, & - wholly the work of the encrustation of stalactite – the height of the roof is full sixty feet – the length 80 feet breadth 50 feet – the floor consists of a soft red earth – like impalpable dust – it was extremely interesting to contemplate amid the silence which had rained *[sic]* here for several thousand years (for the natives have a superstitious dread of caves & never enter them). The splendid work of nature, and with the inexplicable circumstance of the bones found on my mind, it was impossible to behold this altar without a new sensation of awful reverence for the mysterious works of the deity. *[Figure 10]* No bones occur in this cave, while a few yards distant is the cave full of them! Passing by the back of the altar we descend rapidly, and enter a smaller gallery which terminates on the brink of a dark precipice called "the well" where there is water the surface of which is 30 feet below. The depth has not been ascertained. On the left hand side of this smaller gallery we ascend by some very gigantic footsteps apparently in stalagmite covering fallen earth – to one still smaller, where some beautifully crystallized carbonate of lime were found. The floor was covered with stalagmite but on cutting we reached the solid rock. On breaking the greater stalactite opposite the well a small hole was found by which another chamber was entered by crawling on hands and knees or sliding; in this the stalagmites of the floor was pretty even, and as it sounded hollow I directed the (*man?*) to cut and at nine inches sinking below we found brown earth, but entirely free from bones! We dug to the rock which we reached at about 3 feet below the stalagmite. One of the most remarkable phenomena of this cave is a very peculiar white ashes looking sort of dust which covers part of the floor and into which at one part (behind the altar) Mr Rankin sank to his middle. It looks like the ashes of burnt bones, and it may be observed that a very peculiar smell pervaded this cave to its very mouth, and somewhat resembles that of burnt bones. I also dug in the red dust at the outer end of the Chapel, but found a few bones only very much broken. Mr Brown 39th Reg't has informed me that when he first entered this caves, few had preceded him, and that at that time, this substance now white was a dark colour and very light, that it ignited, by the drops from the flambeaus and that smoke was seen at the mouth of the cavern for some time after. I am not quite satisfied on this point however, as I saw some of that black earth remaining.

I next descended the cave where bones are found which appear to be entirely different in character from the others: these are caves mainly in solid limestone and the entrance is usually easy, but there is mainly a hole as if formed by the earth or rocks falling in. The bones are found in a red ochreous cement which appears like the matrix of the limestone blocks which hang in horrible airiness over our heads, as we descend. The mouth of the cave consists chiefly of the bone breccia which seems to be the same as that of Gibraltar – it is also in abundance below with large rocks of limestone intermixed in a very irregular manner; wedged in some places together and supported so as to overhang in others, adhering to the brecchia which alone retains them overhead. This brecchia is of a hardness between that of stone and that of earth, in general its outward texture is peculiarly rough like a swallow's nest or rough mortar – the bones in many places project or are slightly attached to its



We then went to a third cave a little distance from the last; the entrance is amongst the blue limestone rocks, and tolerably easy; it soon however becomes steep – and has more the appearance of the Argyle caves than the others – being moist – There was a peculiar sort of stalactite like a cock's comb in graceful drapery like folds – at the lower part – water terminates the descent – probably communicating with the River Bell – as the water was much lower when Mr Rankin visited the cave during the dry season – I found very pure iron ochre in some of the fissures, but no bones. We returned in the evening very tired to Government House.

Saturday 27 June – A native having told us that there was a large cave to the Northward of the Macquarie about 12 miles west out to explore it with the native on horseback behind another man We rode hard – and only reached the hole about 2 oclock – when it turned out to be merely a sinking of the earth, forming a hole of about 10 feet diam.r at the top, and of 30 ft diam.r at the bottom which was about 40 feet from the surface – We saw only a large

Figure 8. Part of diary entries for 26 and 27 June 1830. (Mitchell Library, State Library of NSW C42)

Figure 9. Section and Groundplot of two Caverns at Wellington Valley. (Mitchell 1838 opp. p. 361)

outward surface, and it would therefore seem clear that this cement was mixed in a very liquid state – the largest bones are generally found outside – and the smaller ones & little fragments dispersed equally throughout the mass. The lower part of the Cave terminates in two little chambers with separate entrances, both of which have a floor of what appears to be diluvial soil. I dug into both but found only few bones, these being apparently of the same sort as those found in the brecchia. The chambers are terminated or rather choked up by this dilluvium. In the smallest and upper one, the bones occur in the face of the rock, encrusted in a thick stalagmite crust or stratum of limestone. I took specimens of this, and also a drawing showing the position of the bones, and the face filled up with diluvium.

We then went to a third cave, a little distance from the last; the entrance is amongst the blue limestone rocks, and tolerably easy; it soon however becomes steep, and has more the appearance of the Argyle caves than the other, being moist. There was a peculiar sort of stalactite like a cock's comb in graceful draping like folds. At the lower part, water terminates the descent, probably connecting with the River Bell as this ~~part~~ *[word crossed out in original & "water" written over it]* water was much lower when Mr Rankin visited the cave during the dry season. I found very pure iron colour in some of the fissures, but no bones. We returned in the evening very tired to Government House.

Saturday 27 June

A native having told us that there was a large cave to the Northward of the Macquarie about 12 miles went out to explore it, with the native on horseback behind another man. We rode hard, and only reached the hole about 2 oclock – when it turned out to be mainly a sinking of the earth, forming a hole of about 10 feet diam'r at the top, and of 30ft descen't, at the bottom of which was about 40 feet from the surface. We saw only a large goanna at the bottom. I was the first to descend by a rope, but I was dissappointed to find no subterraneous passage to go further. The rock consisted of blue clay slate, the country was rather flat, and as I found some thin nodules of magnesian limestone near this, I concluded that this aperture was occasioned by some chasm in some limestone below. This day we rode at least 45 miles without much advantage. We saw a cleartopt *[sic]* hill to the N. East, which being conspicuous also and isolated, is a good point for the survey, the native name is Wingewarra.

Sunday 28th June

We were all rather tired this morning. I wrote letters to Mrs. M. and to Col'l Snodgrass. We drove out to the Caves at 1 o'clock and looked at them a little.

Monday 29th June

We set out for the caves early determined to have a good day's work, I surveyed first the large cave with the compass and a line of 20 feet – then I commenced a view of the large gallery with the great altar & then I measured to the bone cave (80feet), and surveyed it, commencing also a view of the little chamber already mentioned. I this day set men to dig where the brecchia seemed to come to the surface at some distance from the bone cave, and there also they soon found bones – the brecchia being very hard, seemed only a species of limestone rock.

Tuesday 30th June

Went with Mr Kinghorne and a man on horseback carrying the theodolite, across the River Macquarie to a high hill named Bingalyjan, about 5 miles E of the station at Wellington. On our way we touched at a cave in a low situation in the Limestone rock, and in the earthy sides at the mouth I found the same red earth or cement and containing bones. The cave has also like the bone cave at Wellington the appearance of the earth having sank or slidden down the lower part being nearly perpendicular of the footing near its edge of loose earth. I could not descend for want of a rope and a light. I was much struck however with the analogy in character between this & the bone cave at Wellington both seeming like holes formed by a sliding in or sinking of the earth, and neither being at all like the other limestone caves. There was another cave into which the bats when scared from the other cave descend. From Bingalyjan I took angles on the Canobolas and on various hills at Wellington. We also saw some very remarkable peaks at a great distance Northward, these I concluded were on the great range extending from the interior to Cape Hawke [*Howe?*]. The country to the Westward of Wellington seems gradually softening into a level & unbroken country although I saw some hills to the Westward which were rather conspicuous. A vast plain of good land is stated to be at a place named Bogan, to which the natives are very desirous that we about extend the colony. They are a civil & obliging race of blacks.

Wednesday 1st July

Sent my things to the tents near the caves, and proceeded, accompanied by Mr Kinghorne to the heights Westward of Wellington and took angles from two stations across the country on both banks of the Bell. I then proceeded to a little trap hill E. of the Bell and also took angles there, returning in the evening to my tent. I afterwards went down into the Big Cave and completed my view of the beautiful Stalactites round "the Altar". Returned home at ½ p. 12.

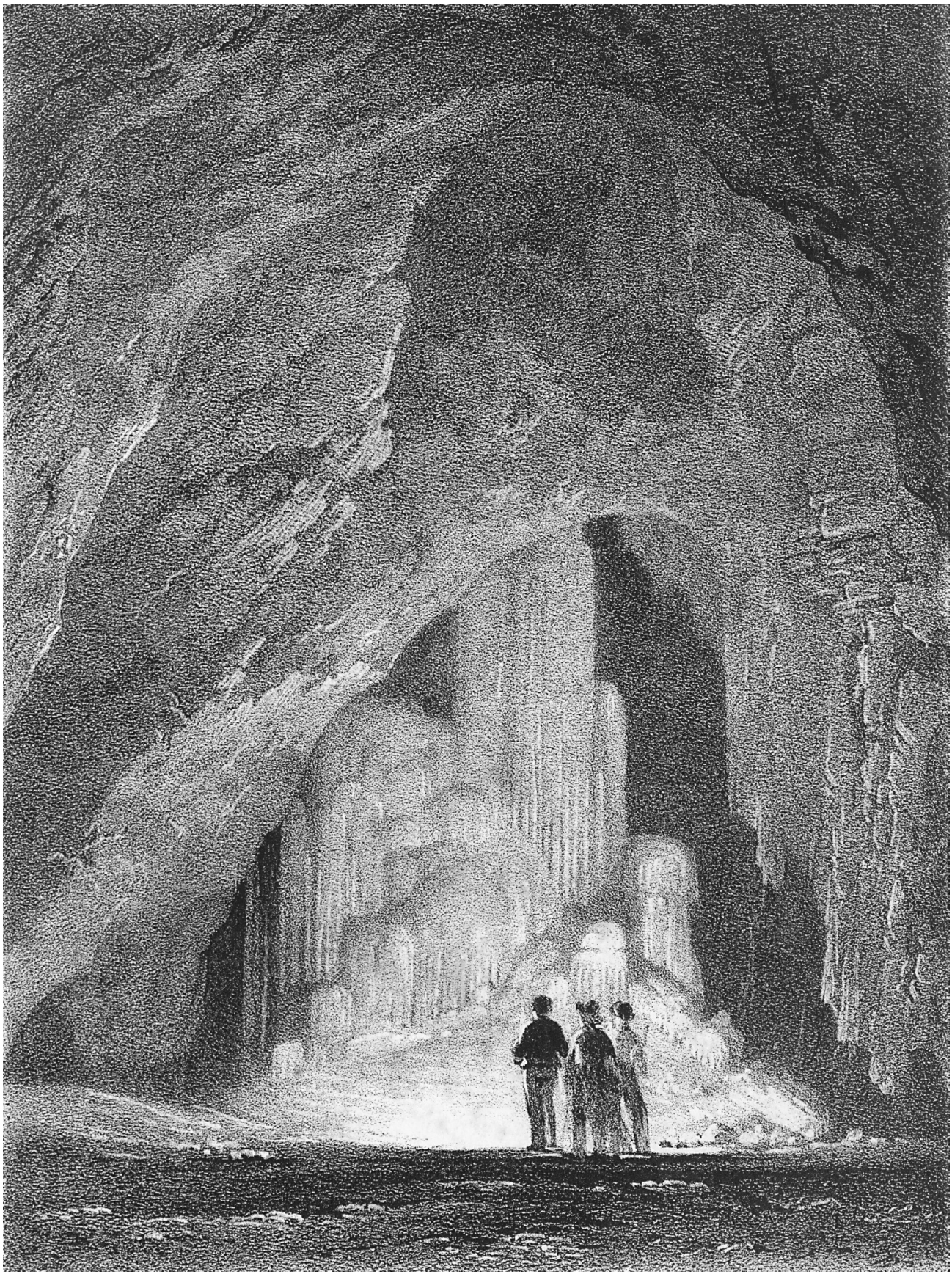


Figure 10. Large cavern at Wellington Valley (Cathedral Cave showing The Altar). (Mitchell 1838, opp. p. 360)

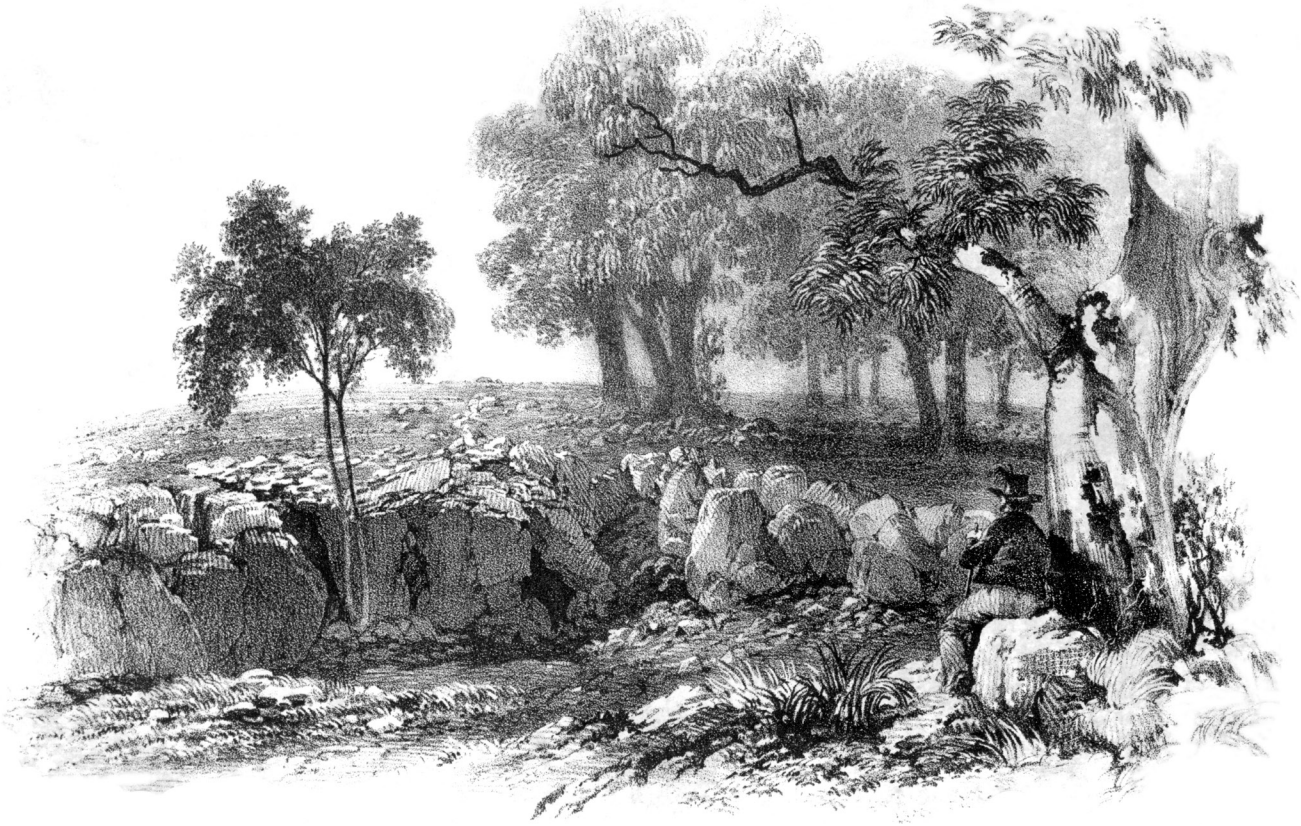


Figure 11. Entrance to the largest cavern, Wellington Valley. (Mitchell 1838, opp. p. 353)

Thursday 2d July

Commenced early with the theodolite at a tree on the bare ground near the Caves (V), and proceeded across the Bell to the higher ground on the West, and traced the summit of the ridges, as far as my station of yesterday. In the evening went into the bone cave.

Friday 3d July

Surveyed the River Bell from above the Caves to its junction with the River Macquarie about 2 miles. This morning I was examining the top of the swell in which the caves are, and tracing the outcrop of the boney red earth, when I came upon a portion exposed to the weather on which were embedded several bones, forming a beautiful and rare specimen . These bones appeared to be the shattered remains of a human being but so scattered and disjointed that only enough remains to identify the order of being to which they belonged.

Like the last remains of a shipwreck, they lay a melancholy vestige of a tremendous storm; and I could not behold these vestiges of a being once animated like myself, after but which had existed long prior to the earliest Egyptian mummy without *[some illegible words crossed out here]* the most elevated and interesting reflecting. Could this being be but reanimated, what light could it not throw on this most puzzling question. How and when comes the red earth always containing bones? This might have been a body from Asia, and was at least as ancient as Noah!

As I was anxious to complete my survey of the river while the weather continued good, I could not remain to examine the hill further as I wished to do. I sent Mr Rankin and Mr Kinghorne who went to the hill & pulled the stones about but found nothing more.

On returning from the Macquarie dined with Mr Kinghorne and in the evening saw a fine Corrobory behind his house. The natives now take in these dances various animals – as the native dog and the manner in which they kill the Kangaroo: the Kangaroo and the natives hunting him, also birds as the crow for instance, and the Emu also, and even they imitate the wind, which was the finale in a very good by taking each boughs of trees and crossing hands rapidly as wind blows branches according to the music, to which they also keep time by a kind of breathing sigh which suited well with a representation of trees waving with wind. This beautiful idea of nature's own children was a greater treat to me than any ballet I ever saw on the stage. I mounted my horse again at nine o'clock and rode to the camp (3½ miles). I then descended the bone cave in order to detach some specimens of the encrustation of bones in one of the chambers, but on descending I found some bones which seemed human, projecting from between two limestone rocks, and I attempted in vain, till it was twelve o'clock, to detach these bones so firmly were they wedged in and I was obliged to leave them there at last, with the exception of some fragments which I brought away. I at length got to the spot below where I wanted the specimens, but I found the aperture filled with a mass of fallen rock, which had come down from the yawning sides since I

had been there before however we got the specimens I wanted. On returning I could not help stepping to the right and taking a sketch of the overhanging rocks mixed with the red-bone earth which looked tremendous, as if every moment they were coming down, finished this at ½ p. 1 and left the cave.

Saturday 4th July

Got up early to pack my specimens, Mr Kinghorne having kindly furnished me with boxes, wood & and I was engaged in this from daylight till 12 o'clock then I breakfasted, Mr Rankin having been waiting for me from 10 o'clock. Then I took a sketch of the mouth of the big *[this last word is repeated on next page]* <u>& Mr Maxwell exchanged my poor bullocks for an excellent team</u>. *[this last line on the page was added separately, then squeezed into a small space after the previous line, then underlined]*

[new page in original]
big cave, while Rankin waited very patiently as we were to have set out on our return at 10 oc'k. While I was drawing Rankin read a poem he had written in which he noticed most flatteringly my survey, drawings & at Wellington I remarked that it was most encouraging to me to finish the drawing with some pains, & not mind time, as I could not otherwise deserve the credit he had given me in the poems. Finished at 1 o'ck, and we proceeded in Mr R's gig towards Molong. On the way we met Mr Walker who returned with us and we all slept at the soldiers Hut at Molong – havg arrd abt 9 oc.

Thursday *[sic–Sunday]* 5th July

Very rainy morning. We proceeded nevertheless to Buree, a Govt' station about 12 miles off. There we saw Hunt – Huntell's – friend. Mr Rankin begged him to sing, but he excused himself saying he was hoarse. He held my horse for me, and put my foot in the stirrup (Prodigious!!!). Olivir the overseer conducted us to the limestone bridge about six miles East of the Gov't station and I found this the most romantic spot I ever saw in my life, although that day was very rainy, we soon got into fair weather under the bridge where there is a spacious esplanade with the most romantic scenery. The bridge is 125 feet span of solid limestone, the height about 60 feet. The breadth of fine dry space is very considerable under "the bridge", rocks (looking Westward) topple up in the style of Salvation, to the left is a covered terrace and this extends into spacious caves or chambers, lighted in the most romantic manner by small openings to the daylight. There are however, on the other hand, dark shapes, and badgers *[sic – wombats?]* seem very numerous, living in holes made under ground. In one dark cell we found fresh remains of a fire and the mark of a foot with a native *[?]* shoe, very fresh, as the badgers had not marked it with their feet. We were rather alarmed at this, as it was well-known that bushrangers are about this part of the country. We however discovered nothing of this kind. Olivir went back to the station for some provisions as we had resolved to remain there for the night. We therefore did so and I passed it tolerably well with a Kangaroo cloak brought by Oliver who returned to us after dark

Monday 6 July

Made a sketch of the interior view of the bridge, completed it by ten o'clock and we then mounted and descended the stream about a mile to the other cave. This is also adjoining the rivulet and a tributary coming through the cave joins at the entrance. This subterraneous part is still, narrow and deep. The Cave is of a different character from those we had seen (which indeed all differ from each other), the stalactites formed columns much like Gothic work, and the appearance from the interior is very picturesque – apertures above, but a dim religious light to it, which entering among the smoke from a fire we lighted gave a fine effect. Under a remarkable mass of stalagmitic crust under which were various stones (<u>not</u> lime) cemented we found lumps of salt petre embedded, and I have no doubt that it might be washed here. No cave of importance appeared with the exception of the narrow fissures in which the stream has its course. Up this Mr Rankin & Mr Walker proceeded, I remained to draw), and were absent a long time, at length they made their appearance having ascended by an inlet to the opposite side of the hill. They found the passage long and dangerous, the stream is so deep that they could find no bottom, and across this they had to stride in moving up, having taken off their shoes to preserve a footing in the rock on each side. To these gentlemen's perseverance I am indebted for the discovery of the <u>"red ochreous cement"</u> all containing bones in this cave also. Just as they were about to ascend by a rough & very steep ascent in a crevice, their light being mostly done, Mr Walker noticed a bone in the side of the opening, and soon they broke out some & brought them to me. The hole by which they ascended to day-light was precisely one of the falling-in kind, loose stones & red earth with bones, from the lowest depth to the surface. The hole at the surface, with a perpendicular opening, resembled exactly the bone caves at Wellington and beyond the Macquarie, and on ascending to the first footing place, 10 feet from the surface, I soon found bones in the earth at the sides. From one little spot I found a great number wedged in tightly and then in another place, others, especially one which seemed like a humerus and ulna of the human skeleton. It may be observed that in this and the former cave we found small bones coated with lime, and in this the same kind of bones lay without any orientation thick on the surface, so as to crack & stick upon our feet like shells on a sea beach.

In the last cave we also found recent marks of an inhabitant's embers, and a tied bunch of reeds as for a bed in the interior of the cave. We now mounted and returned home to Molong. I gave Oliver two dollars for his trouble. I was much incommoded by the boils in riding

back. On our arrival at Molong we found a Dr Henderson waiting for us – by the bye we found it difficult to cross the river, which is I believe the Bell or a branch of it – the other at Buree with the bridge &c, empties into the Lachlan. Dr Henderson seemed a very odd personage – he walked with a black boy – he said there was no granite, nor any primitive rock in the country, that he was making a section of the strata etc. He said he was going to Wellington, and wished to have gone 70 miles further, he rode on drays to carry him over the rivers – he read a book of his to Rankin on financial arrangements and said he was come from Van Diemens Land where he had done much good, to set us right too, for we were all wrong &c &c.

Tuesday 7th July

Mr Rankin set off to get home that night to Bathurst 56 miles, Mr Walker with Dr Henderson went towards Wellington Valley. I required a little rest & quiet but I should nevertheless have gone on but that they had arranged to let the bullocks go astray. I therefore continued in the tent completing the plan of Wellington Valley. By Rankin I wrote to Col'l Snodgrass and Mrs M. The day was rather hot.

Wednesday 8th July

Took a walk in the morning the same limestone rock about 500 yards west of my camp near the side of the river. There was a small crevice or oven-like hole in the rock, and I found it half-filled with the red-ochreous cement, and in detaching a portion from the roof, a small bone appeared adhering to the roof – in fact I found again here the same breccia *[spelling as in original]* of bones. On looking into another crevice that too was half-filled. The surface of this substance having the rough appearance as at other places where I had seen it, resembling a swallow's nest something. There was a crust something like that at Wellington, and I think the boney mass was all above it. I took specimens of both. This was therefore the fourth place which I had found this singular earth – or limestone – <u>always containing bones</u>. These small holes both communicate with the surface above. Moved forward with the dray following, towards Bathurst and camped on the station on a good large rivulet ab't 12 miles from Summer Hill.

Thursday 9th July

Moved onwards, got to Summer Hill about 2 oc'k, ascended a hill North of the station, and took some angles on the Canobolas, and met Mr Lachlan etc. The dray in crossing a rivulet in a swamp just beyond this station lost a wheel, and wetted both the boxes containing specimens. Got the length of Charley Booths (Dr Richardson's land), dist'ce travelled 22 miles. This night the therm'r was 26°

Friday 10th July

Detained a little in the morning in packing & repacking the large specimen from Wellington, then we started and reached after dark Mr Rankin's paddock – called at Mr Rankin's – but a Mr Lambert there & his daughter who is very pretty – Mr Rankin sent to Bathurst for my letters, and for medicine for me.

At Bathurst

Saturday 10th July

Took salts, and finished my plan of Well'n. Valley, Mr Brown 57th called, and I delivered him a packet of English letters he had received from Mrs M. whom he had seen the week before at Sydney, all well, at Mr Rankins in the evening.

Sunday 11th July

Commenced an outline of the sketch of the bone cave, Capt Piper invited me to dine, I sent an excuse, being ill & taking physic, Major McPherson called.

Monday 12th July

Took salts. Continued the drawing of the bone cave very cold & snowy.

Tuesday 13th

Wrote various letters – Mr Rankin called.

Wednesday 14th July

Drew till 1 o'clock – then received my letters, one from Snodgrass, announcing the defalcation of Gregson, has £150 of my money! Wrote answers.

Thursday 15th July

Wrote till 12 o'cl'k then sent off my letters. They were just in time, having been interrupted in the morning by Capt. Steel with Capt Piper who came to visit me. The former of course about his land. Mr Hawkins also called ab't land.

Friday 16th July

Commenced a drawing of the little cave of incrustation of bones. Mr Gosling called on land and detained me a long time. Two men & a pack-horse came into me in the evening in search of Mr Rogers who had sent them on from Sydney.

Saturday 17th July

Completed the drawing of the bone Cave.

Sunday 18th July

Commenced an outline of the view of the entrance to the great Cave. In the evening scrolled the heads of a letter on the Act proposed for the regulation of Towns.

Monday 19th July

Drawing the entrance the Cave – rather rainy.

Tuesday 20th July

Completed the entrance to the Cave.

Wednesday 21st July *[NOTE: original has "20th" with a "1" written over "0"]*

Received letter from Col'l Snodgrass, Laidley and Perry, the first enclosing me my 2d bill for £10, with the letter of advice Laidley leaving caught the fellow on his arrival. I was as much pleased with this bill as if it had been a gift. Wrote a letter to the Sec'y ab't the Department generally etc. One about Elliot. Mr Rogers arrived, bringing his plotting & letters.

Thursday 22nd July

Got upon my horse, a man following with the theodolite, and called on Cap't Piper, then went to the hills below Bathurst and took angles, then went into the Settlement and called on Maj'r McPherson, Mr Everton, & Mr Howard the Commiss'r.

Friday 23rd July

A beautiful morning, protracting my angles when Brown called, he rode with me to the hill near Bathurst which I reached after one o'c'k. We met Maj'r McPherson who went with Mr Moore 39th to look at my specimens at my tent. Mr Moore pronounced the bones to be human he having been bred a Surgeon. On the hills till Sunset. On reaching home heard Mr Rankin had returned. Wrote Mr Rogers instructions - he had been this day employed tracing the houses of the present settlement. Went up to Mr Rankin's in the evening.

Saturday 24 July

Packed up all the specimens carefully, breakfasted with Mr Rankin. The dray moved on to ~~Sydney~~ Bathurst where a months rations were procured – it then went forwards on the road to Sydney. Obtained from Mr Everton, the loan of a team, to draw Mr ~~Richards~~ Rogers rations to Molong, he being instructed to proceed with the pack horse and 20 days rations on surveying trips leaving his stores at Molong with one man near the Mills *[?]* station. I had a busy day surveying the hills Westward of Bathurst which I fortunately completed about 4 o'cl'k. Then called on Maj'r McPherson, Mr Everton (with whom I left the sketch having inserted the names of Selectors. Dined with Brown meeting Mr Rankin. The night was very dark (ab't 9 o'c'k). When I set forward for my camp on the road to Sydney, Brown sent a dragoon with me, otherwise I cl'd not have found the road - reached my tent at ab't 12 miles from Bathurst. The soldiers staid all night. Found my tent most uncomfortably pitched - door right towards a very high wind blowing - and being also exactly where some overhanging rotten trees, at midnight the wind roared & it rained incessantly till the next morning.

Bathurst to Sydney

25 July – 3 August 1830

After leaving Bathurst Mitchell resumed oversight of the roadwork for several days, then continued towards Sydney.

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Obituary:
Kenneth George Grimes 19 October 1944 – 17 August 2016

Susan White

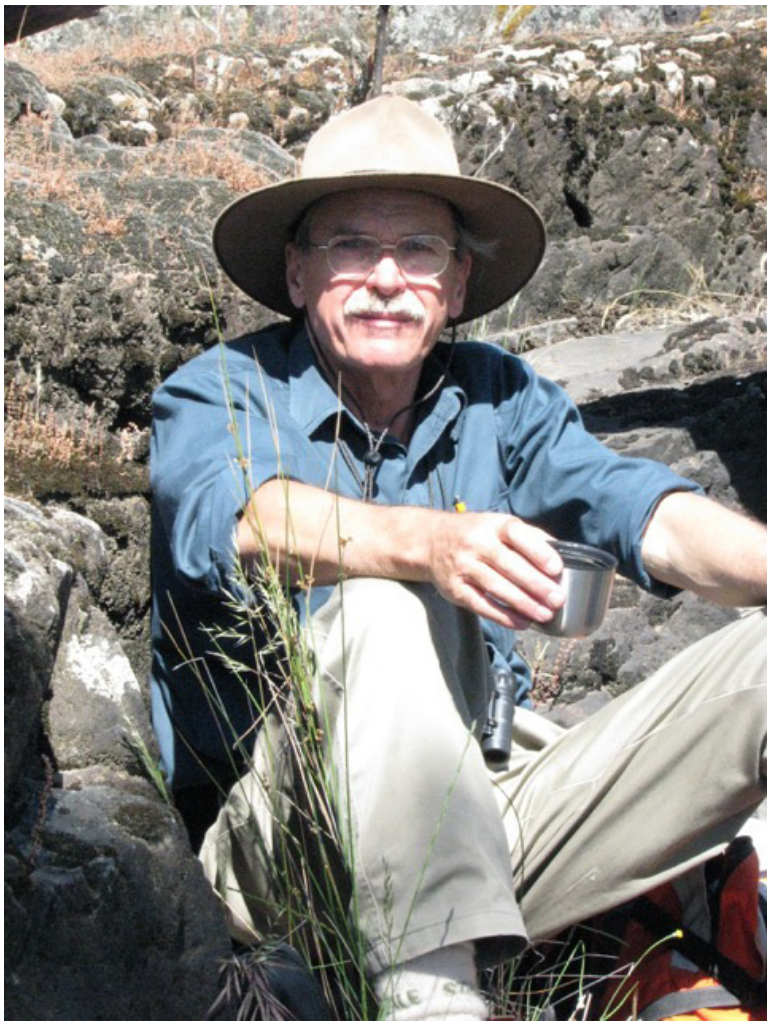
Kenneth George Grimes grew up on a beef cattle property near Proston, Queensland, the youngest of a large family. His early schooling was by correspondence until he was 9, followed by boarding school in Toowoomba for primary and then Brisbane Grammar School. At 'Grammar' he so disliked the inner city environment that he became determined to work in the bush. As a result he studied geology and geomorphology at the University of Queensland on a cadetship from the Queensland Department of Mines, graduating with a BSc (Hons) in 1968. He undertook further studies in 1973-79 mainly in geography and geomorphology.

Since he loved outdoor activities (but NOT competitive sport!) he joined the bushwalking and caving clubs at the University where he met Janeen; they married in late 1970. In the University of Queensland Speleological Society (UQSS), he joined such luminaries as Henry Shannon, Dave Gillieson, Tony Sprent and Michael Bourke. As a member of various caving clubs, UQSS, and later VSA, CCV and CEGSA, he was a stalwart speleologist. He received ASF's Edie Smith Award in 2009 for his outstanding service to Australian speleology over many decades. He was involved with the Australian Speleological Federation as convenor of the Surveying and Mapping Standards Commission, and was Queensland co-ordinator of the Australian Karst Index for the period 1975-1991. He has been a co-editor of *Helictite*, the Journal of Australasian Speleological Research, since 1999. He was also a Fellow of the Australasian Cave & Karst Management Association. Many of us have copies of his well-illustrated field guides for various cave and karst meetings in western Victoria and SE South Australia.

From 1969 to 1991 he was a Geologist in the Regional Mapping Section of the Geological Survey of Queensland (GSQ) where he was assigned to the joint BMR-GSQ team that was charged with the task of mapping the Mesozoic and Cenozoic deposits of the Carpentaria and Karumba Basins of north Queensland. As part of that team, Ken undertook fieldwork throughout northwest Queensland, the Gulf Country and Cape York Peninsula from 1969 to 1973. Ken made a major contribution to the interpretation of the Cenozoic geology and landscape development of the region by extending the use of duricrust stratigraphy. Subsequent weathering geochronological studies are in general agreement with the scheme that he developed. Ken went on to apply his expertise to mapping Cenozoic deposits and regolith in central and southern Queensland including the sand masses of the Fraser Coast region, including Cooloola and Fraser Island.

In 1985 Ken's interest in karst, combined with his skill in mapping Cenozoic deposits, led to his involvement in research on the Tertiary Riversleigh fossil sites with Mike Archer and others. Ken made an important contribution through his ability to distinguish Cenozoic carbonate deposits from the Cambrian limestones on aerial photographs and in the field, thereby expanding the search area and leading to the discovery of several significant fossil vertebrate sites.

As early as 1973 he produced a report on Ashford Cave in far northern NSW, in which he subtly refuted any suggestion that it might replace (in either scientific or recreational terms) the Texas Caves, were they to be flooded by a dam. In 1978 Ken prepared a significant paper on the geology and geomorphology of the Texas Caves in SE Queensland, published by the Queensland Museum. This work benefited significantly from work done on the caves by UQSS and much of Ken's fieldwork was done in association with that society (which became defunct about the mid 80s).



Through most of the 1980s, he had a roving brief as a Cenozoic specialist attached to the various GSQ mapping teams. He became the department's expert on the Cenozoic and there are very few Queensland geology maps which do not bear his name. Although subjected to friendly banter about 'mapping dirt' by the 'hard rockers' that dominated the teams, his skill in subdividing the otherwise blank areas of the map sheets was nonetheless valued as an essential input to any project. When it came to banter, Ken could give back as good as he received, but was always ready to share his knowledge and, apart from the many maps, reports and papers that he contributed to, his geological legacy in Queensland lives on in the influence he had on those who adopted and continued to use his approach to mapping the Cenozoic. His scheme for regolith unit compilation was used for Geoscience Australia's 1:1M digital surface geology map of Australia (2009).

Having grown up on a grazing property, Ken was a natural bushman and this served him in good stead working as a young geologist in Cape York Peninsula, far from assistance if anything went wrong. In later years, he could be relied on to turn up to rescue colleagues who found themselves in difficulties, such as hopelessly bogged, hung up in some wash-out or with a flat battery or mechanical problems. Therefore, it was somewhat embarrassing for him, when mapping on Fraser Island in the mid-1970s, his vehicle became bogged in a creek at low tide. The hapless vehicle was submerged by several high tides before it could be retrieved, eventually towed out by a landing barge!

In the pre-GPS days and using black-and-white, small-scale aerial photographs, Ken was a skilful navigator through the featureless bush that characterises much of the Cenozoic in outback Queensland. Although tending to be quiet in the office, Ken was a good companion around the camp-fire with his dry wit, and his culinary skills with the camp-oven were legendary.

In 1990 Ken and Janeen moved to western Victoria where he was able to specialize more on karst and had limestone and volcanic caves close by. His consulting expanded with more cave and karst work in various places: Naracoorte SA, many places

in Victoria, Tasmania, Christmas Island, Bullita and the sandstone pseudokarst of northern Australia, to name a few. His interest in volcanic caves grew and he has been involved in exploration, documentation and working out the processes involved in basalt cave formation.

He has published many papers and reports on caves and karst and was a widely respected speleologist especially, but not exclusively, in the Cenozoic karst and volcanic areas. In particular these include Australian cave and karst areas in general, karsts of eastern and northern Australia, tropical karren and microkarren, tropical island karst, karst hydrology, karst in less consolidated limestones including syngenetic karst, pseudokarst terminology and lava caves. He also wrote or edited a series of field guides to the karst and pseudokarst of southeastern South Australia and western Victoria. In 2012 he wrote for and edited the *Helictite* volume on the Proterozoic Northern Territory Judbarra / Gregory Karst, which contains Australia's longest cave system. He has also published extensively on the karst in the dune limestones of southern Australia. As a Research Associate in the Environmental Geoscience group at Latrobe University, he was very generous with his time and assistance to post graduate students.

He was a member of GSA and since coming to Victoria has been a corresponding member of the Geological Heritage subcommittee with a very real interest in the geological heritage of the volcanics of western Victoria. His talks to the Victorian Division, delivered wearing his 'volcanic' beanie, were greatly appreciated.

Ken was also a very accomplished artist. He always drew in the margins of books and on the walls and furniture of the old homestead. His cartoons were brilliant and included his quirky sense of humour; some of the recent ones can be seen on the Hamilton Field Naturalists website! He was a keen photographer.

Ken was a wonderful person who had the ability to communicate his vast knowledge and wisdom to people right across the spectrum of scientific understanding; an eminent, witty and a very active cave explorer and thinker. He was very generous with his time and knowledge to visitors to the lava and limestone cave areas of western Victoria and various geologists needing advice. We all valued him as a great friend, very generous with his knowledge, information and well-drafted cave maps which he made freely available to all.

Ken was killed on 17 August by a falling tree on their property near Hamilton, Victoria, while clearing a couple of jammed fallen trees. I can't believe we have lost so suddenly such a good friend and huge contributor to the understanding of the natural world. Ken's presence will be missed enormously by the entire speleological and geological community across Australia, and especially those of us who have worked closely with him.

Information for Contributors to Helictite from 2017

Aims and Scope of Helictite

Contributions from all fields of study related to speleology and karst will be considered for publication. Fields include earth sciences, speleochemistry, hydrology, meteorology, conservation and management, biospeleology, history, major exploration (expedition) reports, equipment and techniques, surveying and cartography, photography and documentation.

Our main geographic focus is Australasia: Australia, New Zealand, New Guinea and the Malay Archipelago, but we also invite studies from the Pacific and Indian Oceans and Antarctica.

Papers should not exceed 10,000 words, plus figures. Contributors intending to write at greater length or requiring any advice on details of preparation are invited to correspond with the Editors at ozspeleo@iinet.net.au. Short notes or 'Letters to the Editor', expressing a personal view or giving a preliminary report of interesting findings, are also welcomed. Discussions of published papers should be received within six months of the publication date, and will be passed on to the original author for response.

All submitted papers will be peer reviewed. The editors reserve the right to determine whether any particular contribution will be accepted for publication.

The process of submission, review and publication.

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2. Submission of the manuscript, including graphics.
3. Peer Review.

   Decision upon tentative acceptance (possibly subject to minor corrections, major corrections or resubmission).
4. Revision by the author(s).

   Papers with major corrections or resubmitted papers may be subject to a second review.
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Authors' names should be given, in the preferred form, below the title. Postal address or institution name should also be provided for each author, together with e-mail address, at least for the lead author.

Papers should be preceded by a brief abstract summarising their content and highlighting their significant findings.

References should be used to indicate outside sources of information, using the 'Harvard system'. In-text citations should give the author's surname

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Maps and line diagrams should be provided as separate files, **not** pasted into text files. LZW-compressed TIF or PNG formats are preferred. Graphics may be in black & white, greyscale or colour. Text should be large enough to be readable even if reduced. Scale should only be shown in bar form (not expressed in words). It is preferred that individual graphics be designed to be published no larger than A4. If images are scanned from original artwork they should be at no less than 300 dpi.

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