

A Study of Cave in New Zealand

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1. Bullock Creek Caves

The Bullock Creek Caves are located adjacent to the usually dry river bed of Bullock Creek, which reaches the sea about a kilometer north of Punakaiki. The caves have been comprehensively written up by Rodgers(1972).

Under conditions of normal water flow Bullock Creek submerges where the stream meets limestone on the west side of the Punakaiki syncline. In flood conditions it overflows the first submergence and progressively floods a series of smaller submergences down valley until it comes to the caves shown on the map. All these with the exception of Wazpretti Cave and Dry Valley Cave are probably more or less flooded during and after heavy rain.

Approximately 1,500 metres south of the submergence is a well defined resurgence cave (Cave Creek Cave, not shown) the active part of this resurges in Cave Creek a tributary of the Pororari River. This has usually been assumed to be the resurgence for Bullock

Creek but two colourings with dye failed to establish a connection. A further attempt with larger quantities of dye and a longer sampling period proved to be successful.

It is assumed that the main Bullock Creek Caves (Telluris, Winding Staircase, parts of the Xanadu System) are former submergence caves of Bullock Creek showing progressive headwater recession.

The character of the caves varies considerably, but nearly all show considerable joint control with a series of joints at about 315° magnetic being most important. In Xanadu and possibly other caves bedding plane control has also been important, the dip of the limestone being $5-7^{\circ}$ in this area, many passages follow the dip very closely.

The development of the caves has not been studied but some observations are possible. The caves have all formed down dip from Bullock Creek with the exception of Wazpretti Cave which is up dip and appears of a different character to the main caves, it is no longer active and there are extensive calcite deposits.

The other caves are all almost completely without decoration. The active caves with the exception of Winding Staircase, are all on the south side of the creek bed.

Several developmental phases are evident in Xanadu. There are several areas of tortuous maze which have evidently formed phreatically, as shown by the meandering anastomosing roof half

tubes and the segments of more or less circular cross section. At least three phases there is often a vadose trench.

There is also the remnants of a calcified false floor in this maze suggesting a period of gravel deposition and subsequent erosion, a process still continuing in side passages of Cairns.

In a very simplified way two main types of passage are visible in Xanadu, relatively level passages, often maze-like following a bedding plane, intersected by near vertical narrow rift type passages.

The other caves generally lack the intricate mazes of Xanadu. The main passage of Cairns Catacombs is a large high stream passage which still acts as one of the most important overflow submergences for Bullock Creek. Phreatic development is less apparent except in some of the side passages near the main sump.

All the major caves end in sumps 60-70m below the creek bed. Further vadose extensions are generally unlikely in this direction as the sumps must be close to the level of the resurgence. Active streams are present in Xanadu, Kubla Khan, Telluris, and Cataract Pot.

It is possible that the main caves including Cataract Pot could drain into a largely submerged master cave, also collecting water from the main submergence of which Cave Creek Cave could be a portion.

The history of discovery has been discussed by Rodgers (1972). Although one of the caves was entered by Tony Rodgers and others

in 1964 it was not until July 1969 that systematic caving took place. Most of the main passages of the Xanadu System were found in July and August 1969 but it was not until September 1970 that it was all tied together.

Most of the other main systems were also first visited in 1969 and were largely explored by the end of 1970, although smaller discoveries continue up to the present time. Surveying got underway in May 1970 (Graham Wilson, Xanadu) and gradually spread to all the more important caves.

Bruce Annabell has been largely responsible for the overland survey and for tidying up the numerous small holes. The Xanadu system with 4,900m of surveyed passage is now the third longest surveyed system in New Zealand.

Many members of C.C.G. and G.C.G., too numerous to mention have made significant contributions to the exploration and surveying of the Bullock Creek Caves. All surveys have been made with a tape, compass and inclinometer.

In general, most of the main caves are accessible with minimal equipment. 10m ladders are necessary to visit parts of Cairns and Kubla Khan. Winding Staircase has two pitches one of 10m and one of 12m. The Peters Pot and Mikes entrance of Telluris need 15m of ladder and Cataract Pot has an entrance shaft of 42m.

I wish to thank Professor Paul Williams for pointing out various

features in Xanadu.

2. Canterbury Hill Cave, Collingwood

This is but a brief description of a cave which, although well known to local inhabitants, appears to be unknown to the N.Z.S.S. It is reputed to be one of several caves in this region, but we have so far been unable to continue our prospecting here as fully as is needed.

The cave is in no way unique nor of an outstanding nature; being within an isolated remnant of a much younger limestone which appears to have once extensively overlain the old Paleozoic basement rocks of the Aorere valley region.

It seems probable that it is in the same limestone as the well-known Te Anaroa tourist cave, at Rockville near Collingwood, and that of the Brown River caves south of Bainham.

Canterbury Hill cave is approximately 5-7km S.E. of Te Anaroa Cave, and is quite prominent in so far as the limestone remnant is a distinct hill with a more lush vegetation cover than the surrounding pakihi plateau.

On 7.5.72 Roger Newman and I visited this cave, after having been directed to it by an old gold prospector we chanced to meet. The nearest point by road is about 1.5km south of Te Anaroa Cave and

The Devil Boots. We then walked for about one hour in a S.E. direction, climbing gently all the while across the marshy pakihi land. Finally we came upon the stream shown in the locality sketch.

By following up this stream yet always remaining on its north bank, we followed around a small hill to a small depression filled with bush. This is the most accessible entrance. After a climb down about 5m we were in a stream passage cave, that seemed to finish in a rockfall after about 70m.

However a tight squeeze through a pool of water let us go into a continuation of the same big stream passage. Presently the main passage forked, and we followed on down the stream.

This involved climbing around several deep pools. Later daylight could be seen; we came out into the bottom of a deep bush-filled gully. This lower entrance is about 20m high, with large strands of moss hanging in it; very reminiscent of the large entrance of the Metro system, Charleston.

As we had not looked at side-passages we returned back through the cave. Going up the western fork we came upon areas of live formation and low roof. Up here we were surprised to find a large panel of slate forming one wall section, and upon it a multitude of carved signatures. Some of these names dated back to the 1870's; many gave dates prior to 1900; and many were done in very beautiful Gothic script and decorative italics.

Contrary to the usual vandalistic effect produced by most graffiti, this panel of carefully carved names and dates is actually very interesting and aesthetic.

A notable feature of this cave is that the floor has been cut down to the base of the limestone. In several places the black slates (typical of the Ordovician basement rocks in this region) are well exposed and steeply-dipping. This cave has yet to be surveyed. N.S.G. has since visited it and done prospecting in this area.

In 1907 the N.Z. Geological Survey Bulletin 3 was accompanied by geologic and topographic maps showing the location of two caves, and on page 31 stated: "The caves which occur in the limestone buttes near the Bedstead Road, are probably the most extensive in the Parapara subdivision.

There are at least two large caves and probably many smaller ones in the largest butte. One of these traverses the butte, with many branches.

It is exceedingly damp, and though of large proportions it is not a great beauty, as stalactites are generally rare, and in places lacking altogether. The other cave is more beautiful, since its form simulates a galleried domed edifice.

Moa-bones are said to have been found within this cave." It would seem that Bell, Webb and Clarke had not studied the following report made by Haast and Hochstetter in 1859. (Hochstetter, F. von

(1864):Geologie von Neuseeland.)

3. Moa Bone Caves in Aorere Valley

1) Stafford's Cave, named by the miners because a former visitor, Mr. Stafford, broke his leg in it, is the most northern of the three caves. The entrance lies concealed in the undergrowth, but is otherwise wide and open.

A steep conical shaft leads down for a depth of about 80 ft from the floor of the cave; at the bottom, rammed in between the two walls, lies a great block of limestone below which a rivulet streams forth, flowing through the cave, which runs from east; in the cave it is joined by a little tributary.

It leaves the cave, under the name of Doctor's Creek, to discharge into the Aorere.

On the northern entrance wall, at the base, thick beds of yellow sandy limestone, very readily friable, can be observed; above, 4-8ft thick, a hard bed of conglomerate (quartz, phyllites, and gneiss pebbles with calcareous cement); the roof of the cave is formed of fine-grained sandy limestone with fossils, but the floor of steeply dipping phyllite beds (fundamental slate) dipping at 45° to the west.

The long pendant stalactites and the vertical fall of the stream, for

a height of almost 10 ft, prevented me from investigating the cave to the exit. The water that flows through it has allowed no deposit of loam, and after I had convinced myself that there was nowhere any favourable terrain to set about excavation, I went to the second or middle cave. It is not unlikely that the two caves are connected with each other by side-branches.

But beforehand, I investigated the little creek to see whether there were not any peculiar cave inhabitants to be found in it. There was, however, no trace of animal life to be found. Only weakly shining glow worms occupied the moist ceiling above.

2) Hochstetter's Cave. The entrance to the second and larger cave, which I call Hochstetter's Cave, lies a few hundred yards south of Stafford's Cave and 50 60 ft higher. The limestone here forms a high airy portal, surrounded by luxuriant vegetation, partly overgrown by ferns and mosses, between which hang prettily shaped, dazzling white stalactites.

Here too the visitor has to climb down for about 100 ft over a steeply sloping loamy debris-cone, till the cave itself is reached. Great blocks of rock piled one above the other lie underfoot and only after clambering over these do you reach the smooth floor of the cave. This consists partly of encrustations of calcareous sinter, sometimes most magnificent and beautiful in form, partly of sand and

silt.

The cave extends from east to west and has several arms branching off to north and south. At several points the ceilings rise to considerable heights and forms a cupola of imposing beauty which the light from a dozed candles cannot illuminate clearly.

Its breadth varies between 30 and 80 ft; but after about 500 yards it becomes so narrow that it is impossible to go further. Here too I observed cave glow-worms and discovered a second cave-dweller, and insect similar to the weta with very long antennae, which tried to escape capture by long jumps.

I began excavations about 200 yards from the entrance at a place where the partly disturbed soil showed that somebody else had dug before, and where Dr. Hochstetter himself had found odd fragments of bone.

A sublime quiet reigned in the cave, broken only by the fall of occasional drops of water, and it presented a peculiarly awe-inspiring sight, if one withdrew into the dark recesses and saw the shapes of strong men working silently - each one standing up to his chest in a pit lit up by two candles. It seemed as if each were digging a grave in this quiet place!

The cupola, quite a hundred foot above, was scarcely touched by the light which, flickering in ghostly fashion, was reflected from the shining side walls. In clear moonlight we stepped out into the open

air, inhaling the fresh evening the fresh evening air with delight.

Some days before, however, I had found a third cave, south-east of Hochstetter's cave, about 200 yards distant and 50 ft higher up the slope, to which I now betook myself to continue my researches.

3) Moa Cave. The access leads down like a shaft and is 3 to 4 ft wide. Projecting rocks make the descent very easy. Also a giant bird could easily get down there. After this a steep slope begins, consisting of soil that has been washed down. On this one enters the cave for a further 15 ft. It extends from north to south, is 8-15 ft high, 20-40 ft broad and 80 ft long.

At the end of the cave, a second opening similar to the entrance leads into stalagmite columns, narrow the interior in many places. This cave I called Moa Cave on account of the many moa bones we found right at the entrance.

In it the scattered and to some extent broken bones which lay round about showed us that others had been here before us; this was the chief cave where gold diggers had dug for bones and where the complete skeleton had been found of which we had been told.

4. A Philosophy of Cave Conservation

Conservation is the optimum sustained use of natural resources; therefore, cave conservation must provide not only for the protection of the character, decoration and biota of caves, but also for the means whereby people might enjoy and understand the caves that are their heritage.

A cave is a natural subterranean cavity into which a man can enter to a point where daylight cannot be seen.

Caves are not only interesting physical entities that provide distinctive sensory and perceptual experiences and invoke a variety of responses, but they also provide unique opportunities for scientific study.

Speleology is the study of caves, and in New Zealand it attracts workers from many disciplines of the universities and government research establishments.

A caver is a person who visits or explores caves as a hobby. A speleologist studies caves and their contents and records the findings.

Observations show that caves change, and that the rock, water and air are in a state of delicate physical balance. Caves are the habitat of animal species, some of which are never seen on the surface, and their need for sanctuary must not be overlooked.

The evidence of man's prehistoric use of caves must be properly

recorded as a valuable part of archaeology, and the inclusion in cave deposits of the skeletons of extinct flightless birds, has added to our knowledge of these species.

A cave is, in a broad sense, a recreational resource, that is, one of the means of supplying the want of modern urbanised man to refresh his mind by relaxation and by participation in a substantially different experience that has no economic significance of its own.

Today there are ever-increasing pressures on all types of recreational areas, because more people have more leisure time.

Better roads make it easier for thousands of urban dwellers to visit remote areas, and the world-wide boom in travel brings many foreign visitors to our tourist attractions.

A commercial cave is defined as a cave that is accessible and open to the public at specified times. It has an administration that is responsible for cave protection and for visitor safety, and the tours - whether guided or self-guided - include explanations.

There are hundreds of beautiful and interesting limestone caves in New Zealand, but although about 8 per cent of the land is set aside as National Parks so that the public might always enjoy the beautiful and unique features, only Fiordland National Park contains a tourist cave. The inclusion of Te Ana- in that park was only an accident, and not an administrative decision by people who felt strongly about our beautiful caves.

A further 1 per cent of the land is set aside as scenic reserves and these smaller areas contain many limestone caves, including the three Government operated caves at Waitomo.

Information is being gathered for future proposed protection, acquisition, or development of some of the more outstanding caves. Many New Zealanders know more about the surface of the moon than about the nature of a cave, and many landowners know that vertical caves are a menace to animals and a convenient dump for old carcasses. Speleologists must inform people about caves, and also point out that they are a delicate natural resource of potential recreational, scientific and commercial interest.

Sometimes the lure of mystery and adventure has to be prevailed upon to entice people underground, but carefully planned commercialisation of a beautiful and interesting cave will bring pleasure to thousands of visitors and reduce the possibility of defacement by unthinking and un disciplined persons in an uncontrolled cave.

Some caves have been completely stripped of almost every mineral decoration by vandals and rock-hounds. For conservation reasons it is not advisable to publish the precise locations of unprotected caves. It is also an unfortunate fact that cavers do more damage to more caves than most visitors do to tourist caves in a century. In terms of the human time scale the careless defacement of cave decoration or

character is very difficult to restore.

Commercial development of a cave must be not only for recreation, but also for success. An ill-conceived venture might be a disservice rather than a benefit and destroy the objectives that it set out to achieve.

Most major tourist caves of the world are Government controlled because it would be too expensive for private enterprise to attempt to develop large caves on a realistic investment-return formula. Also, a spectacular cave is a natural phenomenon that should not be owned by an individual, nor should the resort be operated as a commercial monopoly.

Conservation of a cave, in conjunction with its commercial use for tourism, can be achieved if three points are remembered:

- a. The natural character of the cave must not be lost in the development.
- b. The ecology of the distinctive fauna must be assured.
- c. The recreational value of the cave tour must not be lost by crowding with too many visitors.

5. Public Interest in Commercial Caves

There are many reasons for persons visiting commercial caves, but two broad groups are easily recognised. To a bus load of "Package-deal" tourists a cave is yet another stop to be added to their long itinerary of places that they have visited. Many of them have no real interest in the cave apart from getting out of the sight of daylight and returning as quickly and safely as possible.

To other visitors a cave is a genuinely new and mysterious world which they have been unable to visit as a caver or speleologist, but they are interested enough to overcome their fears and to find out for themselves what a cave is really like. A third possible minor group are those who feel a compulsion to visit a cave as a symbolic or psychic experience.

6. Experiences associated with a cave visit

Although a visitor to a commercial cave is denied much of the organisational involvement and excitement that is an essential part of an expedition to an unexplored cave, he is involved in the personal activity of inspecting an enclosing physical environment that is substantially different from anything on the surface of the earth.

Visits to places of difficult access tend to inspire mystical experiences - the straining of the body, the achieving of a goal, the feeling of solitude and unity with the earth, the opportunity for rest and reflection - of being at peace with something beyond oneself.

In a cave the absolute darkness, the deathly silence, and the removal of familiar every-day things enhance these experiences and make the cave visitor aware of his dependence on his companions and upon himself. Camaraderie and antagonisms can be boldly highlighted.

A cave visit also produces emotional experiences. The lure of the unseen and the unknown is contrasted with the fear of not remembering the route out, or the fear of being cut off by a sudden flood or roof collapse.

The exhilaration of walking and climbing is complemented by the physical struggles, the cold, the wet, and the mud. The excitement of discovering a sparkling, white chamber is balanced against the hours of seeing only dull, uninteresting rock and mud. Finally, the pleasure

and relief of a safe return to daylight from a remote, alien and timeless world, is inextricably mixed with tiredness or exhaustion from the adventure.

The challenge of logically piecing together the numerous observations and the deduction of relationships between the seen and the unseen lead to the intellectual contemplation of the origins and nature of the cave and its life, and of the future of the things now visible.

Visually the most awe-inspiring experience is the utter darkness when lights are turned out, or are inadequate to penetrate the distance. In New Zealand many caves are never completely dark because of the cheering blue lights of glowworms which can be bright enough to silhouette shapes or illuminate light coloured areas like faces, and collectively make an unforgettable spectacle.

With adequate lights the unusual rock shapes, the delicate calcite and gypsum decorations, the shadows cast by moving lights, the sparkle of crystals, the various mineral colours, and the unexpected tiny living things all excite the visual imagination.

Conversely, smashed stalactites are detracting, and the sight of human litter or contrivances associated with extravagant or tasteless presentation in a commercial cave is unforgivable.

Aurally the negative experience of silence can be profound, and the boat ride in Glowworm Grotto is greatly enhanced by the visitors

remaining silent.

If silence is prolonged while one is alone in complete darkness it can become terrifying. The shape of a chamber or the texture of its walls can produce a complete lack of echo. Within the confines of a chamber the dripping of water, the babble of a stream, or the thunder of a waterfall, each produce aural impressions that are stimulating. By contrast, the introduction of unnatural sound or inappropriate recorded music in a commercial cave can be offensive.

Tactile experience of a commercial cave is usually denied to the visitors. Intimate contact with hard rock, wet surfaces, soft mud, smooth calcite or rough limestone should be available, in the appropriate places, to all cave visitors.

However, the fragility of delicate stalactites should not be experimented with by every visitor. The sense of being confined within definite solid limits is very real and makes some cave visitors fearful.

The odour of dank, musty cave deposits is distinctive and should not be displaced by the stale smell of human breath and perspiration. Commercial caves should not be allowed to be polluted by the wafting odours of food, nor by the nauseating smell of rotting animal carcasses, human urine or excrement, nor by petrol or oil fumes.

Taste is the only faculty that is not distinctively stimulated by a cave visit. Groundwater enriched with calcium carbonate is common to

all springs and streams in limestone terrain.

Within a cave a feeling of clamminess is quickly noticed. This is produced by the almost saturated humid atmosphere affecting perspiration rates during physical activity. If excess carbon dioxide is present, a feeling of suffocation might be experienced. The almost constant temperature of a cave makes it feel cool in summer and warm in winter. Air currents can sometimes be felt and they add to the mystery of a cave.

7. General Development Requirements for Commercial Caves.

Environs: One of the most valuable assets a potential tourist cave can have is a favourable location near a population centre, but this is not always possible because of the rugged nature of limestone landscapes (karst).

A cave must be rare or unique to attract visitors away from main routes. Important caves should be protected within Crown reserves which should adequately cover the land surface and natural vegetation above and around the cave.

Approach: A visit to a cave should be both educational and dramatic. The entrance is an important feature of any cave, and this

should be preserved without too much modification. The interior of a cave is often judged by the visitor, before he even enters, by the appearance of the buildings.

Planning of surface facilities must consider preservation and protection of the cave below - vegetation, soil, and drainage must not be disturbed. Waste disposal from buildings and pavements must be strictly controlled.

Caves become dead and dusty after natural vegetation has been stripped and natural percolation drainage changed. Even reforestation with pines could be detrimental to the drainage and therefore to the deposition of calcite. Changes in humidity caused by artificial tunnels and shafts cause dustiness, and doors should be installed at such points.

Obviously adequate facilities like carpark, waiting hall, restaurant, snack-bar, toilets, interpretative displays, etc., must be provided by the controlling authority.

Paths: Paving the floor makes it convenient for the visitor, but destroys some of the natural aspects of the cave, such as rimstone, flowstone, cave pearls, and crystal pools.

Grouping areas where the guide can explain features of the cave are necessary. There should be easy access for maintenance and construction materials and for servicing. The superintendent of the

construction work must guard against the destruction of features of the caves he is intending to display. Hand labour cannot be eliminated. Retaining walls, abutments and handrails should enhance the cave.

Gradients should allow for comfortable walking, but some steep narrow or low passages add to the sense of adventure. For most of the length of the pathways there should be headroom of about 2m, and a width wherever possible of at least 1.2m.

Paths should resist flood waters, and be built to a high standard of safety, e.g., non-corrosive coatings on metal and non-skid surfaces on concrete or asphalt. Wood should be used sparingly, and if gravel paths are necessary they should have shoulders to prevent the stones scattering.

Lighting: This must show the caves dimensions and decorations to dramatic and educational advantage. Scientific measurements of light absorption and reflection should be made before installations are finalised, fo that extraneous plant growth is not encouraged.

Lights should be low and accessible, but never visible to the visitors. Visitors will not always travel in one direction so lights can not be directed from behind.

There could be special night time illumination of the entrance or special boat tours on nights near the full moon. Underwater lights or

under-path lights can be used. The gradual illumination of big chambers, or sequential lighting of a series of features can be very effective, if not overdone.

Guides: One of the most important factors in a cave tour is the excellence of the guide.

His confidence and enthusiasm directly influence the enjoyment and understanding of the whole party of visitors who should feel that they are being shepherded, by someone who cares about them and the cave, rather than scrambling, sliding and splashing through the cave in pursuit of the guide. He must never show boredom, and a sense of humour is necessary.

Information given by guides is accepted without question, and he must be authoritative and backed by the management who should be responsible to see that errors, misinformation, and old wives' tales are not passed on to the public.

The ill-informed, unsympathetic and disinterested guide can make a superb cave seem dreary and unpleasant, while an informed, articulate and enthusiastic guide can make even a moderately interesting cave an adventure.

Guides must be heard above other sounds of river, wind, voices, shuffling feet, etc.

Information pamphlets must be available (to bona fide overseas

visitors) in several languages, and portable tape recorders with cassettes of recorded commentaries (Japanese, French, German, Spanish, etc) should be carried by the guides.

A cave of restricted size requires small parties, and if facilities within the cave are restricted in size it would improve the quality of the tours considerably if the party with each guide was limited to that number.