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Bungonia Gorge, near Marulan, N.S.W. The near-vertical left hand wall is approximately 800 ft high. The slope rises a further 200 ft to the plateau which contains the Bungonia caves. The limestone mountain on the right is almost completely unexplored due to difficulty of access and high cliff faces.

Photo: A. Healy.

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REVIEW

AN EVALUATION OF THE RATE AND DISTRIBUTION OF LIMESTONE SOLUTION AND DEPOSITION IN THE RIVER FERGUS BASIN, WESTERN IRELAND. By P.W. Williams. In Contributions to the Study of Karst. Australian National University, Canberra, Dept. Geography Pub. G/5, 1968 : 1 - 40, pl. 1 - 6, figs. 1 - 5.

This paper is reviewed here as it is published by an Australian university and may not be seen by all interested speleologists in other countries.

The paper describes a quantitative study of limestone solution in a river basin of 528 km^2 in western Ireland. Most of the basin is underlain by Carboniferous limestone, but the headwaters of some of the surface streams lie on sandstone and shale. These are undersaturated and capable of solution when they reach the limestone, whereas surface streams with headwaters solely on limestone are largely saturated and are apparently capable only of mechanical abrasion and transport. Solution by vertically percolating water is important in removing limestone, particularly in the centre of the basin where surface streams and underground water is saturated. This solution occurs within a few metres of the ground surface. It is concluded that net limestone solution from the basin amounts to 51 m^3/year/km^2 and that it is possible for known caves to have been excavated in Postglacial times. The irregularity of limestone solution in time and place is marked, and although the reason for the irregularity is not discussed, Williams suggests this may account for the characteristic irregularity of humid karst topography.

Williams has given a good account of the limestone solution, and the paper can be added to the growing list of quantitative studies of limestone weathering. - D.C.L.

THE CLASTIC SEDIMENTS OF DOUGLAS CAVE, STUART TOWN, NEW SOUTH WALES

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Introduction

Douglas Cave is on the western slopes of central New South Wales about five miles southwest of Stuart Town. The cave was first discovered in 1896 by R.J. Wilson (Leigh, 1897). At the time of discovery, the accumulation of fossil bone in the Bone Room was noted and shortly afterwards some bone was collected by W.S. Leigh. *Thylacinus spelaeus*, *Dasyurus* sp. and *Macropus* sp. were included in the collection (Dun, 1897). The cave was not named when it was discovered, though Trickett does refer to it as "the Stuart Town Caves" in a later report (Trickett, 1898, p. 205). It will be referred to hereafter as the Douglas Cave in honour of the present owner.

Description

Douglas Cave (Figure 1) is essentially one room, approximately 50 feet by 100 feet, with a few short side passages developed along bedding planes. A line of columns divides the room into two roughly equal parts. A shale bed outcrops along the west wall of the main room and another occurs near the entrance to the Bone Room. The entrance is a small collapse doline which leads, via a vertical drop of about 6 feet, to the apex of a breakdown cone which slopes south-westward. About half the floor of the first part of the room is covered with this breakdown together with a few fragments of old speleothems. The remainder of the floor is covered with flowstone, except for a small part along the west wall where recent surface-derived soil has accumulated.

The floor of the east part of the room is relatively level and is covered almost entirely with recent surface-derived soil. There is a small patch of flowstone along the north wall and a smaller patch of guano nearby.

The Bone Room has a floor which slopes south-westward and is composed of an older and petrographically different surface-derived soil. At the south end of the cave there is a second room which is almost filled with large blocks of breakdown.

The Limestone

Douglas Cave is in the upper part of the Lower Devonian Nubrigyn Formation as described by Wolf (1965) and others. According to Wolf (1965, p. 158), the Nubrigyn is a shallow water reef sediment composed of "very impure algal detrital limestone" with andesite rock fragments, quartz and plagioclase sometimes exceeding 50%. Beds of shale, mudstones and andesitic lava flows are interbedded with the limestone. Algal bioherms and biostromes from a few feet to 1,000 feet in length and up to 200 feet thick occur in the Nubrigyn. The Nubrigyn Formation is on the east flank of the Molong Geanticline which is a western part of the larger structural unit making up the Eastern Highlands of Australia. The sediments are extremely faulted and folded and in the vicinity of Douglas Cave the beds are nearly vertical. The cave is developed within a relatively pure lens of limestone between two shale beds.

Morphological Features of the Cave

Stratigraphic control may account for the location of the cave, but it has had little effect on the form. The most obvious effect that it has had is along the west wall of the main room where one of the shale beds outcrops. This wall is relatively straight and follows the strike. Remnants of the shale bed attest to the fact that solution was inhibited in this direction by the less soluble shale. The other shale bed which outcrops near the entrance to the Bone Room has probably contributed to the constriction leading into this room.

Three or four joint sets have contributed to prominent features within the cave. One, trending north-westward, has produced a 6 foot scarp which cuts across the entire width of the room (Figure 1, plan and profile 3). A small, narrow, elongate pit extending from the south wall near the scarp is a result of enlargement of a joint in the same set. Another set trending north-eastward has produced a long, narrow pit along the south wall (Figure 1, plan and profile 2). Both sets of these joints are also seen as steps in the ceiling, especially near the south end of the main room (Figure 1, profile 1), and above the highest part of the flowstone covered floor (Figure 1, profile 2). Additional smaller features attributable to other joint sets occur throughout the cave.

The walls and ceiling of the cave show smooth, erosional forms, generally with large radii of curvature. There are very few sharp-angled erosional features and no directional features that could be attributed to erosion by fast-flowing water. The ceiling is planar or gently arched, except where it is interrupted by smooth solution domes or stepping due to joints. Small-scale solution pockets up to 6 inches deep and a foot in diameter occur over most of the ceiling. All of these erosional forms suggest that the cave was developed by solution within the phreatic zone.

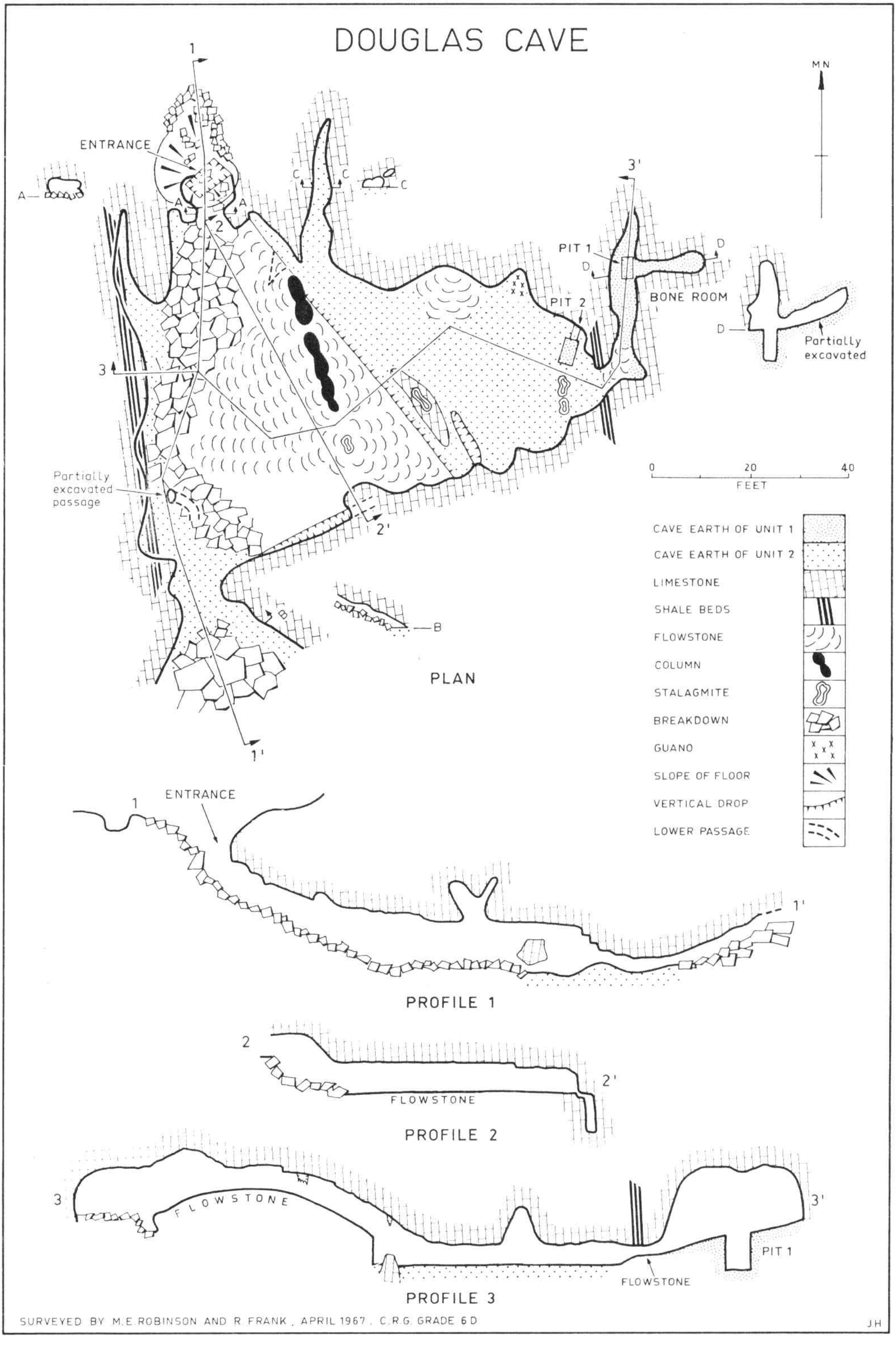
DOUGLAS CAVE
MN
ENTRANCE
PIT 1
PIT 2
BONE ROOM
Partially excavated
Partially excavated passage
0 20 40
FEET
CAVE EARTH OF UNIT 1
CAVE EARTH OF UNIT 2
LIMESTONE
SHALE BEDS
FLOWSTONE
COLUMN
STALAGMITE
BREAKDOWN
GUANO
SLOPE OF FLOOR
VERTICAL DROP
LOWER PASSAGE
PLAN
PROFILE 1
FLOWSTONE
PROFILE 2
FLOWSTONE
FLOWSTONE
PROFILE 3
SURVEYED BY M.E. ROBINSON AND R. FRANK, APRIL 1967. C.R.G. GRADE 6D
JH

Figure 1.

Description of the Cave Sediments

Douglas Cave has had two main episodes of filling with one nondepositional or erosional interval. The two episodes of filling are represented by two distinct stratigraphic units. Pit 1 in the Bone Room exposes the lower unit 1 for approximately 8 feet. A description of this sequence is as follows.

0 to 4 feet 6 inches - Red, silty clay with 3-5% calcite cement, patchily distributed. 3-10% angular limestone, shale and volcanic rock fragments up to 2 feet in diameter. Bone of large animals abundant in top 2 feet, becoming more sparse in lower part. Bedding virtually indiscernible except for poorly oriented long bones and some flat rock fragments. Strikes approximately east-west with 7-10 deg. dip to the south. One mouse-sized animal burrow about 2 feet from the top.

4 feet 6 inches to 8 feet - Dark-brown to red-brown, silty clay with less than 1% calcite cement, patchily distributed. 5-20% limestone, shale and volcanic rock fragments up to 2 feet in diameter. Size and abundance of rock fragments increases with depth. Bones of small animals abundant. Bones of large animals sparse. 2-3% broken flowstone fragments and other speleothems near bottom. One angular limestone rock fragment, 1 foot in diameter, partially disintegrated with thin layer of guano on top. One rounded, 6 inch diameter limestone rock fragment. Charcoal flecks up to ¼ inch sparsely distributed throughout intervals from 6 to 6½ feet.

No bedrock was reached in pit 1, but the increasing number of large limestone rock fragments and the broken flowstone and speleothems seem to indicate that the bedrock was not far below.

Unit 2 has a total thickness of about 4 feet. A complete section is exposed in pit 2. A description of this unit is as follows.

0 to 1 foot - Red, sandy, silty clay with 2-4% small animal bone fragments. Occasional large animal bone fragments. Horizontal bedding is due to very poor grading. A 1½ inch thick gravelly sand layer occurs at the bottom and increases in thickness towards the centre of the room.

1 foot to 2 feet 4 inches - Light-brown to dark-yellow, laminated, slightly silty clay with 1-2% small animal bone fragments. Occasional large animal bone fragments. Laminations vary from 1/8 to 1 inch and average ¼ inch. Desiccation cracks with pyrolusite staining are restricted to individual lamine and are filled with silty clay of overlying laminae. Scattered thin lenses of guano with invertebrate burrows in silty clay beneath guano lenses. Mouse-sized burrows sparsely scattered throughout. One contains fecal pellets. Bedding is slightly dis-

rupted around burrows. White splotches of phosphate (?) associated with three burrows. Sparsely distributed calcite cemented nodules 1-2 inches in diameter have formed in place as evidenced by bedding running through them.

2 feet 4 inches to 3 feet 3 inches - Red-brown, poorly graded, silty clay to gravelly sand with 2-4% small animal bone fragments. Occasional large animal bone fragments.

3 feet 3 inches to top of flowstone layer - Red-brown, sandy, silty clay with 10-20% limestone, shale and volcanic rock fragments up to 1 foot in diameter. 2-4% animal bone fragments. 1-2% large animal bone fragments increasing with depth. Small amounts of broken flowstone and other speleothems.

Flowstone layer - Averages about 1 foot thick. Occurs as 1-2 inch thick lenses containing abundant gravelly, sandy, silty clay. Occasional thin lenses of detritus-free calcite. 5-10% small and large animal bone fragments. Strikes approximately N70E and dips about 12 deg. north-westward.

Unit 1 is exposed over most of the floor of the Bone Room. Unit 2 occurs throughout the east half of the main room and similar material lies in a low part of the floor along the west wall.

ANALYSES OF THE SEDIMENTS

Unit 1 was sampled vertically each 6 inches from 0 feet 6 inches to 6 feet 6 inches. Unit 2 was sampled every 4 inches from 0 feet 0 inches to 3 feet. In addition, one sample was taken of the material between 3 feet and the top of the flowstone layer, one of the flowstone layer, and one of the material beneath the flowstone layer. The surface soil was sampled every 1 foot for a depth of 5 feet in a washout about 300 feet west of the cave. Samples of the limestone, shale and volcanic rock fragments were also taken from the surface near the cave. X-ray analysis of the clays of each sample was done and thin sections of 14 of the samples were examined briefly under a petrographic microscope.

The less than 2 micron fraction was prepared for X-ray analysis using the method of carbonate extraction described by Jonas (1959) and Horn (1967). The samples were analysed as oriented slides on a Philips model PW 1051 X-ray diffractometer using Ni filtered Cu K alpha radiation through slits of $1/4^{o}$- 0.2^{o}- $1/4^{o}$.

Results of the X-ray Analysis of the Clays

A mineralogical analysis of the clays in the surface soils, the cave sediments and the country rocks showed the following. In the surface soils there is a steady increase in the amount of chlorite and mixed layer clay with depth and an increase in the amount of kaolinite from 0 to 3 feet and then a decrease to 5 feet; illite (1M and 2M mica) is approximately equal in each of the five samples. In unit 1 there is a steady increase in the amount of chlorite with depth, a decrease in the amount of kaolinite, and illite (1M and 2M mica) remains approximately the same throughout. Unit 2 shows an increase in the amount of chlorite with depth to about 2 feet then the rate of increase lessens in the remaining part, kaolinite increases to 1 foot 4 inches and then decreases to 3 feet and illite (1M and 2M mica) remains approximately the same throughout the unit. The shale is composed entirely of illite (1M and 2M mica) and the volcanic rock fragments show illite (1M and 2M mica) to be the most abundant with lesser amounts of chlorite. In the limestone illite (2M mica) and chlorite are present in approximately equal amounts.

There are many factors which can affect the soil clays from the time of their formation to the time of their final deposition as cave sediments. However, if the assumptions are made that the clays in the surface soils have responded to climatic changes, have been deposited sequentially in the cave and have undergone essentially no alteration since their deposition, their relative abundance in the cave sediments can be used to arrive at a general interpretation of the past climatic factors to which the surface soils have been subjected.

Grim (1953), Keller (1964) and numerous other authors have shown both theoretically and empirically that different types of clays have a tendency to originate or be stable in different environments. Among the four common clay types - chlorite, illite, montmorillonite and kaolinite - the following environments of formation are generally accepted. Chlorite is formed under a variety of conditions but the presence of Mg and Fe and a minimum amount of leaching favors its formation. Illite, except for the stable 2M polymorph, is usually associated with an arid environment where there is an abundance of K and little or no leaching. Montmorillonite generally forms in an alkaline environment and in the presence of Mg, Fe, Ca, Na, and K, and with a minimum amount of leaching. Kaolinite is associated with humid environments of low pH where leaching is prominent. Its formation is inhibited by the presence of Ca^{++} and Mg^{++}.

On the basis of these generalisations the relative abundance of the clay types through the sedimentary sequence in Douglas Cave indicates an increasingly humid climate from the time of deposition of the lower part of unit 1 to shortly before the present and then a return to drier conditions. This interpretation supports that implied from the sedimentologic evidence for the depositional environment of the cave sediments.

Depositional Environment of the Cave Sediments

The sediments began accumulating a little over 30,000 years ago as shown by the C^{14} date of 29,200 $^{+3,000}_{-2,000}$ BP (GaK-1555) on charcoal deposited near the bottom of unit 1 in the Bone Room.

Material of the oldest sedimentary unit, unit 1, was derived primarily from surface soil, as shown by the mineralogic analyses, and was deposited in an open, aerated cave. It was dumped into the cave with gravity as its main depositing agent and represents the type of cave sediment known as entrance facies material (Kukla and Ložek, 1958). Its mode of deposition is evidenced by the poorly developed stratification and lack of types of bedding that would be produced in water deposited material. The extremely high standard deviation of the particle size of the material, the occasional guano lenses and the animal burrow are additional evidence of a gravity-dumped entrance facies mode of deposition. As pointed out by Ložek and Skřivánek (1966), the angularity of the limestone rock fragments can also be used as partial evidence for material deposited in an open cavity as opposed to simultaneous solution and accumulation.

The conditions prevalent during the accumulation of unit 1 in the vicinity of the Bone Room, then, were as follows. There was an open cavity containing no standing or running water. An opening to the surface, possibly developed along the joint extending in the direction of section D, provided access through which surface soil, animal carcasses, limestone and other rock fragments slowly accumulated (Figure 2A). In the absence of any effective transporting agent, this material gradually filled the surface opening and deposition ceased (Figure 2B).

About the same time that unit 1 was accumulating, other material texturally similar, was being deposited in the southwest part of the cave. The partially excavated passage beneath the breakdown in this area has exposed this material and there is a surface depression, also partially excavated, on the hillside above.

Near the end of unit 1 accumulation, flowstone began to form (Figure 2B). The 1 foot thick layer of flowstone exposed in pit 2 has unit 1 material incorporated in it. In addition to this layer there is a comparable flowstone unit near the entrance to the Bone Room, but most of the floor of the Bone Room is devoid of flowstone. There is no evidence for the time relationships of these flowstone units with the large flowstone area in the west half of the cave.

Flowstone deposition ceased and the material of unit 2 began to accumulate (Figure 2C). $CaCO_3$-charged water present during the accumulation of the flowstone layer still must have been available, but the rate of accumulation of unit 2 was too fast for flowstone to form. Instead, the $CaCO_3$ was deposited in the form of the nodules mentioned earlier where the water could percolate down through desiccation cracks and burrows. The bottom few inches of unit 2 bears a strong resemblance, texturally and mineralogically, to the material of unit 1. Thin sections of samples from the top of unit 1 and from the bottom of unit 2 show a similarity in the degree of alteration of the plagioclase. In addition, X-ray analysis of the clays shows a probable mixing of unit 1 material with fresh material derived from the surface.

In the next phase of deposition of unit 2 some indication of the amount of water present during this time becomes apparent (Figure 2D). The middle 1 foot 4 inches of this unit was deposited in a fluctuating pond which at this time must have extended over the entire east half of the main room of the cave if the direction of dip on the top of unit 1 prevailed throughout this part of the cave. That is not to say that there was no pond before deposition of the laminated part of unit 2. Indeed, there probably was standing water farther toward the centre of the cave if the flowstone and redeposited unit 1 material is any indication. The pond did reach its highest level, however, during the deposition of the laminated part of unit 2, either through an increased amount of water or through partial filling with sediment.

The top 1 foot of unit 2 with its poorly developed graded bedding was probably deposited under conditions similar to those that prevailed before the deposition of the laminated part (Figure 2E). The pond level was falling and did not reach this level of the cave during this time. The desiccation cracks, animal burrows and guano lenses show that the pond occasionally dried up, at least partially, and then was again filled to cover the whole east half of the cave.

It is most probable that the unit 2 material was brought in via the present entrance. If it had entered by the Bone Room opening, flowstone probably would have formed on unit 1 material throughout the Bone Room. Also, there are no lumps of unit 1 material incorporated in the laminated sediment of unit 2.

Two other possible modes of entry by which unit 2 material could have gained access are numerous small cracks and joints and one or more undiscovered larger openings. The first seems unlikely because of the volume of material involved in each lamina and the size of the bone and rock fragments (up to 1 foot). The second also seems inprobable because there is no fill or flowstone or other speleothem-choked sections that could be concealing former entrances.

The conditions prevailing during the deposition of unit 2, then, were as follows. Ponding occurred in the east half of the cave probably due to periodic (seasonal?) flooding with a fluctuating water level but gradually increasing in height until it occasionally covered the entire east half of the cave. Then there was a gradual but fluctuating decline in the water level and finally a complete drying up of the pond. The period of pond fluctuation was interspersed with considerable biologic activity (vertebrate and invertebrate burrows, bat guano).

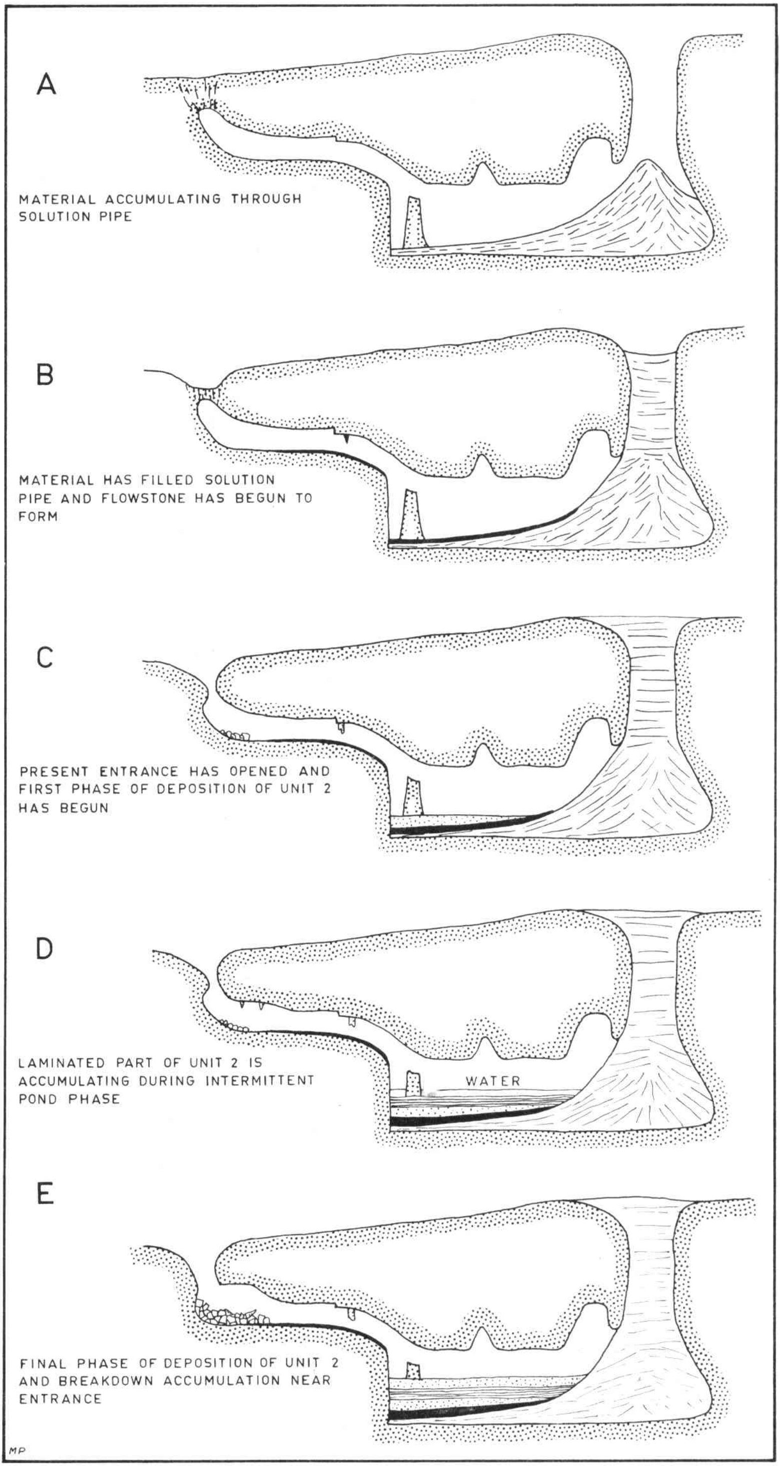

Figure 2. **Diagrammatic profile through Douglas Cave showing the two principal entrances and the sequence of accumulation of the deposits.**

Flowstone and breakdown make up the bulk of the floor deposits in the west half of the cave. As mentioned earlier, the flowstone could possibly be contemporaneous with the flowstone layer separating unit 1 from unit 2; or it could have been deposited any time after this, during the wet period evidenced by the pond deposits of unit 2.

The breakdown, except for that in the south extension, has originated from the present entrance. It has undergone no discernible alteration in the form of solution or cementation. If the postulate is correct that the majority of the pond water entered through the present entrance, then this water would have altered the breakdown if it were present at the time. Hence, the breakdown probably post-dates the pond. In any event, it does overlap the flowstone and covers the unit 1 material in the west half of the cave and so is one of the later deposits.

Summary

The morphological features of Douglas Cave show that it was formed in the phreatic zone with recognisable vadose alteration. A solution pipe, formed along a joint at the eastern end of the cave, was open to the surface a little over 30,000 years ago and admitted surface soil, rock fragments and animal carcasses which produced a gravity-dumped entrance facies type of deposit in the cave. This solution pipe was completely filled by the surface-derived material. The present entrance to the cave, a small collapse doline on the north-western side, was opened to the surface about this time and an increased amount of available water produced a 1 foot thick flowstone layer on the down-dip part of the previously deposited material. Surface soil, rock fragments and animal carcasses were washed into the cave through the doline entrance and accumulated in a pond whose water level fluctuated considerably. The pond eventually dried up completely.

Acknowledgments

I sincerely thank Mr. J.N. Jennings, Department of Geomorphology and Biogeography, Australian National University, and Dr. A.W. Crook, Department of Geology, Australian National University, for their critical reading of the manuscript and helpful suggestions.

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R E V I E W

GEOLOGY AND MINERAL RESOURCES OF TASMANIA. By I.B. Jennings, A.J. Noldart and E. Williams. Geological Survey Bulletin No. 50, Department of Mines, Tasmania, 1967 : pp. 90 + 2 folded maps in pocket. A$1.50.

A complete revision of a 1938 Geological Survey Bulletin summarising knowledge of the geology and mineral deposits of Tasmania to the end of 1966. Part I is a 26-page outline of the geology of Tasmania; Part II discusses the mining industry, and Part III the mineral resources. Numerous references are made in the text to limestone areas. A folded map, contained in a pocket, Mineral Resources Map 'B', Stratified and Residual Deposits, includes outlines of all the Tasmanian limestone areas. - E.A.L.

A B S T R A C T

THE RHAPHIDOPHORIDAE (ORTHOPTERA) OF AUSTRALIA. PART 6. TWO NEW SPECIES FROM NORTHERN TASMANIA. By Aola M. Richards. Pacific Insects, 10 (1), 1968 : 167 - 176.

To date only two species of Rhaphidophoridae have been recorded from Tasmanian caves and both belong to the genus *Micropathus* Richards. A third species of *Micropathus*, *M. fuscus* Richards is now placed in this genus. It is recorded from an unnamed limestone cave near Gunns Plains, Leven Cave L3, Loongana, and the Trowutta Caves, Trowutta, 32 km ESE of Redpa. All localities are in north-western Tasmania. The distribution of the other two species has been extended. New records for *M. tasmaniensis* Richards are forestry track near Denison River; Cashion Creek Cave, Florentine Valley; King George V Cave, Hastings; fissure cave in dolerite, Mt. Arthur (part of Mt. Wellington), Hobart. New records for *M. cavernicola* Richards are Little Trimmer Cave, Mole Creek; Swallownest Cave L5 and Old Tourist Cave L4, L6, Loongana; unnamed cave, Bubs Hill, 25 km E of Queenstown; unnamed cave, Kelly Basin. *Micropathus* now extends throughout the western and southern parts of Tasmania and appears to be the dominant rhaphidophorid genus on the island. There is no overlap in the distribution of the three species. Although the range of *M. cavernicola* and *M. fuscus* converge at Loongana, they have not been collected from the same cave. A key is given for the species of *Micropathus*.

A new monotypic genus *Parvotettix* Richards is recorded from Little Trimmer Cave, Mole Creek. The new species, *P. goedei* Richards is the smallest rhaphidophorid species so far recorded from Australia, the length of the body not exceeding 10 mm in the adult insect. It lives in association with *M. cavernicola*. This species is named for Albert Goede who collected all adult specimens of this species. - A.M.R.

A B S T R A C T

SIGNIFICANCE OF STYLOLITES IN DOLOMITIC LIMESTONES. By J.E. Glover. Nature, 217, 1968 : 835 - 836.

Studies of Western Australian stylolitic limestones strongly support the widely held view that stylolites form by pressure-solution and agree with suggestions that pressure-solution can significantly reduce the volume of carbonate formations. Furthermore, these results indicate that selective pressure-solution of calcite in dolomitic limestone can cause relative enrichment in dolomite, and this allows speculation that the process can form pure dolomite rocks (dolostones) from some dolomitic limestones. Calcite is likely to be released for the cementation of nearby formations, and thinning in the limestone bodies may induce new structures in overlying strata.

AGE OF THE DESICCATED CARCASE OF A THYLACINE (MARSUPIALIA, DASYUROIDEA) FROM THYLACINE HOLE, NULLARBOR REGION, WESTERN AUSTRALIA

JACOBA W.J. LOWRY and D. MERRILEES*

The discovery of a remarkably well preserved carcase of a thylacine (Thylacinus cynocephalus Harris) (Geological Survey of Western Australia specimen F 6364) in Thylacine Hole (N63), a cave on the Hampton Tableland in the far southeast of Western Australia, has been described by Lowry and Lowry (1967). Many other desiccated carcasses or "mummies" were found in the same cave, as well as a large quantity of bones only slightly encrusted with or quite free of adhering soft tissue.

Partridge (1967) also has described a thylacine with desiccated soft tissue (Western Australian Museum specimen 64.8.1) from Murra-el-elevyn Cave (N47) in the Nullarbor region and gave a radiocarbon date (Ga K 693), determined on this soft tissue, of 3,280 + or - 90 years B.P. The Thylacine Hole specimen was much better preserved than the Murra-el-elevyn Cave specimen, and hence was thought to be younger (cf. Merrilees, 1968, Figure 3).

Three radiocarbon date determinations have been made on hair and desiccated skin, muscle and other soft tissue which lay immediately beneath specimen F 6364 in Thylacine Hole, and clearly represented part of the animal concerned, because no other source lay closer than about 100 feet away. As soon as the desiccated carcase was lifted, about 18 g of this loose hair and other dry tissue was transferred by knife blade to aluminium foil and closely wrapped. The dates (N.S.W. 28 a, b and c) on this material are 4,650 + or - 104, 4,550 + or - 112 and 4,650 + or - 153 years B.P. respectively. The sample for date N.S.W. 28c was boiled with hydrochloric acid to remove geologically old carbon in carbonate derived from the roof and walls of the cave. Thus the Thylacine Hole specimen, despite its very complete preservation, is older than that from Murra-el-elevyn Cave, which remains the youngest dated thylacine from the Australian mainland.

The desiccated carcase of a dog (Canis familiaris, presumably a dingo - Geological Survey of Western Australia specimen F 6343) was also found in Thylacine Hole. This dog carcase, because it was much less completely preserved than thylacine F 6364, was thought to be older. However, a radiocarbon date (N.S.W. 30) of 2,200 + or - 96 years B.P. on desiccated soft tissue removed from the dog carcase shows it to be younger than the thylacine.

* Western Australian Museum, Perth.

Since the dingo and thylacine specimens from Thylacine Hole were found only about 200 feet apart, their dates show that conditions of preservation can vary greatly in the same cave, and that state of preservation is not a reliable guide to age. The dates do not show that dingoes and thylacines co-existed in the vicinity of Thylacine Hole as anticipated by Lowry and Lowry (1967) and Merrilees (1968, p. 19).

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R E V I E W

SYNGENETIC KARST IN AUSTRALIA. By J.N. Jennings. In Contributions to the Study of Karst. Australian National University, Canberra, Dept. Geography Pub. G/5, 1968 : 41 - 110.

This paper reviews the distribution of calcareous dunes on the coast of Australia, their lithification, and their development of karst features. Jennings' wide experience of karst morphology enables him to recognise the distinctive karst features of aeolian limestone and to contrast them with the features developed in the more common jointed impermeable marine limestone. Features discussed include the lithification of the sand; the development of solution pipes and gorges of construction; the importance of cave collapse; and the influence of climate, allogenic drainage, and basement topography. Gorges of construction form during dune accumulation; and solution pipe development and some cave collapse are thought to occur during lithification of the dune sand. Thus the formation of the limestone and the development of its karst features partly overlap in time, and this novelty is stressed in the title "Syngenetic Karst". Jennings is in the happy position of being able to draw together information from his field studies ranging from Bass Strait to the west coast of Western Australia, as well as from a diffuse literature and unpublished information of local speleologists.

The paper was presented at a symposium on karst in England in 1964, but continual delays in publication as part of the proceedings caused Jennings to publish the paper in its present form. (Continued on page 20).

INTERPRETATION OF DATA FROM McEACHERN'S CAVE, S.W. VICTORIA

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With the publication in this journal of the review (Jennings, 1968) of certain speleological contributions, it was made evident that some misinterpretation could arise from the data which I presented (Wakefield, 1967) about McEachern's Cave in south-western Victoria.

Apparently, there had been insufficient emphasis on the point that the reddish sand, though dispersed in to the area of the excavation after the floor collapse and stream erosion, did in fact enter the cave before that collapse and erosion. As a result, Jennings indicated that wet conditions were recognised in the cave between the deposition of the calcareous (i.e. aeolian) layer and the recent reddish quartz sand containing the smaller (i.e. Mallee) fauna, and he referred also to "the supposed aeolian phase involving the erosion of more distant calcareous dunes instead of the deflation of nearer quartz sand." These discrepancies are largely resolved when it is noted that quartz sand (reddish) did enter the cave, to accumulate in the area of the entrance, during the aeolian phase.

These matters were discussed at length with Jennings, who eventually wrote (Personal Communication, October 2, 1968): "You have removed many of my doubts about your interpretation of the stratigraphy of the cave. The crux of the matter does seem to lie in this redistribution of material from one part of the cave to another." (He stated also, however, that he remained doubtful about some of the evidence for the aeolian phase.)

The main purpose of this paper is to publish a table which sets out, on the general lines of that drawn up by Jennings (1968), data observed and deduced during the investigation of McEachern's Cave. This should be studied in conjunction with the original paper.

In the original paper (Wakefield, 1967), no suggestion was made as to the source of the white sand that infilled the cavities left by the floor collapse and the stream erosion. This sand moved to the excavation area from the N.W. end of the cave, not from the direction of the entrance shaft. Also, there was no mention in the original paper of the interesting possibility that it was high sea level that resulted in an area of open water in the cave during the arid climatic period.

TABLE OF EVENTS AT

	CAVE EVENTS	DEPOSITS IN EXCAVATION
HOLOCENE	Dispersion of sand entering via main shaft and other pipes.	Black quartz sand, slightly cohesive, some organic content.
	Redistribution of older reddish sand from entrance shaft area.	Reddish quartz sand, slightly cohesive.
	Distribution of white sand from NW end of cave.	White quartz sand, loose, some $CaCO_3$.
	Cave breakdown; floor collapse; stream erosion of sediments.	Newer roof-fall; stream bed rubble of bone and calcarenite.
	Cave larger than present, with major extension towards NW and probably a second opening. Reddish quartz sand accumulates beneath present entrance. Calcareous silt and fine sand, wind-eroded from different surface sediments, brought in by strong air currents through entrance shaft and dispersed in NW chamber of cave. Due to lack of water movement, no dispersion in cave of coarser quartz sand. Secondary cementing of (b) due to high cave air humidity associated with open water elsewhere in cave, possibly due to a higher sea level.	(d) Reddish quartz sand, mixed with grey calcarenite. (c) Grey unlaminated calcareous sand, a little fine quartz sand, some clay, many freshwater ostracod valves, microfossils much abraded. (b) Orange-red calcareous silt and fine sand, a little fine quartz sand, much haematite, microfossils much abraded, half area cemented. (a) Grey, yellow and white, laminated, calcareous silt and fine sand; a little fine quartz sand; microfossils much abraded. (Mixture of reddish quartz sand and calcarenite sediments at SE end of excavation.)
PLEISTOCENE	Accumulation of sand via entrance shaft; and stream action in part of cave.	Brown quartz sand, of medium compaction, unstratified, some organic content; microfossils not abraded.
		Grey quartz sand, stratified and much compacted.
	Cave breakdown.	Older roof-fall.

MAMMALIAN REMAINS	CLIMATE AND HYDROLOGY	CHRONOLOGY	
Modern fauna of dry sclerophyll forest.	As at present.	Modern.	
Dry sclerophyll spp. and Mallee spp.	Similar to present.		
Few bones.			
Bones derived from older beds.	Wetter groundwater conditions than now.	cf. "Little Ice Age", c 3,000 BP.	
No bones in calcarenite; entry in to cave of Mallee species inferred at this time to explain fauna of subsequently redistributed sediments from this phase.	Mallee conditions, with wind erosion of surface areas of district, and reduced underground water movement.	cf. "Mid-Holocene Thermal Period", c 5,000 or 6,000 BP.	
Wet sclerophyll spp., some extinct "giant" Pleistocene spp.	Higher rainfall or reduced evaporation; wetter groundwater conditions than now.	C14 date, 15,200 ±320 BP.	Last Pleistocene Cold Period.
Not assessed.			

The "Little Ice Age" and "Mid-Holocene Thermal Period", in the Chronology column, are quoted from Gill (1955). However, the term "Mid-Holocene" is questioned, for the thermal period appears to have followed immediately after the last Pleistocene cold period. Whether we are in fact in a new geological Epoch, distinct from the Pleistocene, is a moot point, but if the Recent or Holocene Epoch is accepted as such, it must be recognised as having its very beginning at the onset of the thermal or arid period. It would be more appropriate to refer to the latter event as "Early-Holocene".

Corrigenda to Original Paper

Three amendments are required to the earlier paper on McEachern's Cave published in the Victorian Naturalist (Wakefield, 1967). They are:

(a) The spelling of Dury should be corrected on pages 381 and 383.
(b) Details of the reference (Wakefield, 1966) should be inserted on page 383.
(c) In line 14, column 2, page 371, the figures should read 196 and 207 respectively.

Acknowledgment

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References

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ABSTRACT - Continued from p. 16.

Two drawbacks are that the text has a mass of footnotes discussing new information that came to hand in the intervening four years, and that the photographic plates suffer from the offset printing. The paper is important by being the first survey of Australia's aeolianites by a geomorphologist, as well as providing new basic information such as chemical analyses of cave waters. However, little detailed work has been done and the paper is best regarded as an interim survey of a field for active research rather than a collection of final conclusions. - D.C.L.