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Helictite

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"40 Twists" spiral helictite in Puketiti Flower Cave, North Island, New Zealand, shown at about one-third natural size. Note gypsum formations in background.
Photograph by John Pybus.

" H E L I C T I T E "

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CONTENTS

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ABSTRACTS AND REVIEWS

THE ORIGIN OF SMALL CAVITIES IN THE LIMESTONE OF THE BUNDA PLATEAU, EUCLA BASIN. By D.C. Lowry. Geological Survey of Western Australia Annual Report for 1968 : 34 - 37, and Plate 13. 1969.

The limestone of the Bunda Plateau contains several varieties of small cavities between the surface and the watertable some 200 to 400 feet below. Some near-surface cavities have previously been attributed to phreatic solution below a late Cainozoic watertable which stood within a few feet of the present surface, but this article shows that some of the cavities were formed by tree roots and others by surface weathering. Cavities of undoubted phreatic or epi-phreatic origin are recognised only up to about 250 feet above the present watertable, and a late Cainozoic elevation of sea level by that amount is inferred. - Author's abstract.(See page 43 for discussion.)

GEOLOGY OF THE KATHERINE-DARWIN REGION, NORTHERN TERRITORY. By B.P. Walpole, P.W. Crohn, P.R. Dunn, M.A. Randal. With chapters by S.K. Skwarko and J. Hays. Also THE MINES AND MINERAL DEPOSITS OF THE KATHERINE-DARWIN REGION. By P.W. Crohn. Dept. Nat. Dev., Bureau of Min. Res., Geol. and Geophys., Bull. 82. Two vols. (Vol 1 : 304 pp. Vol 2 : 5 folded maps.) 1968.

A general appreciation of the geology and mineral resources of the Katherine-Darwin Region of the Northern Territory of Australia rather than a detailed account. The area studied covers about 40,000 square miles.

Large quantities of limestone occur in several parts of the Region. These are treated briefly in the light of potential economic use as well as from the geological point of view. The only recent economic application recorded is the production of 350 tons of lime at Katherine in 1960-61. Earlier uses of Territory limestone were for limited lime production and as a flux for the smelting of metallic ores.

The Tindall Limestone, roughly paralleling the railroad northwest-southeast of the town of Katherine, appears to be the only cavernous limestone. Sinkholes, springs and caves are common, particularly in the larger outcrops. Extensive caves occur within a few miles of Katherine, including the Kintore Caves (discovered last century). A sinkhole alongside the main street of the town acts as a natural stormwater drain. Warm springs occur at Mataranka and on the Douglas River (southeast of Katherine), where they are associated with minor faults in the Cambrian limestone. Plate 21 shows an example of karst topography in massive and jointed Tindall Limestone, and also a photograph showing the general terrain in the same area.- E.A.L.

SOME CAVES OF KITAVA, TROBRIAND ISLANDS, PAPUA

C.D. OLLIER* and D.K. HOLDSWORTH**

Introduction

The Trobriand group of coral islands is situated 100 miles off the northeast coast of Papua, north of the D'Entrecasteaux Islands. Kitava, the most easterly island of the group, is approximately 4½ miles by 2½ miles. It is 15 miles east of Wawela on the main island of Kiriwina, though 50 miles by sea from Losuia around the north coast of Kiriwina.

The population is approximately 2,000 natives, the majority being subsistence farmers and fishermen. No Europeans live on the island. Yams, taro, sweet potatoes and bananas are the main garden products. Fish, chickens and eggs are eaten, and pigs are used in ceremonial feasts or "sing-sings".

Kitava is served by occasional boats, but cannot be reached by air. The Administration boat, "The Pearl", is based at Losuia and calls at irregular intervals of a few weeks, the journey from Losuia taking about five hours. Kitavans travel far in their canoes, and the ceremonial Kula trade involves journeys to other Trobriand islands, the Amphletts, Dobu and the Woodlark Islands.

The authors spent four days on Kitava in May, 1969, and lived in a native house near the village of Bomapou in the north of the island. Trade tobacco was used as currency to pay for food, and to pay guides and carriers. A trade store has since been established near the beach, a mile from the main village of Kumwageya, and payment in cash may be more acceptable in future. Children appreciate being paid in chewing gum, known throughout the islands as "P.K."

Very little English is spoken on the island and we were fortunate in having the company of Mr. Gilbert Heers who speaks the Kiriwinan language fluently.

Geology

Like the other islands in the Trobriand group, Kitava (Figure 1) is an uplifted coral atoll, but has been raised higher above sea level than the others. The island is saucer-shaped, with the old lagoon now forming a swampy basin in the centre, surrounded by a fairly flat rim - the old reef - which reaches a highest point of 466 feet (142 m).

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Uplift took place in a series of distinct stages and, at each period of stillstand, the growth of a fringing coral reef produced a platform surrounding the island. There are at least five main shelves on the island, often separated by almost vertical cliffs.

Freshwater springs occur only near sea level and, since the villages are nearly all on the top of the island (for the best agricultural land is around the old lagoon), freshwater must be collected either from rainwater or carried laboriously by the women from the shore.

THE CAVES

Inakebu Cave

(See Figure 2)

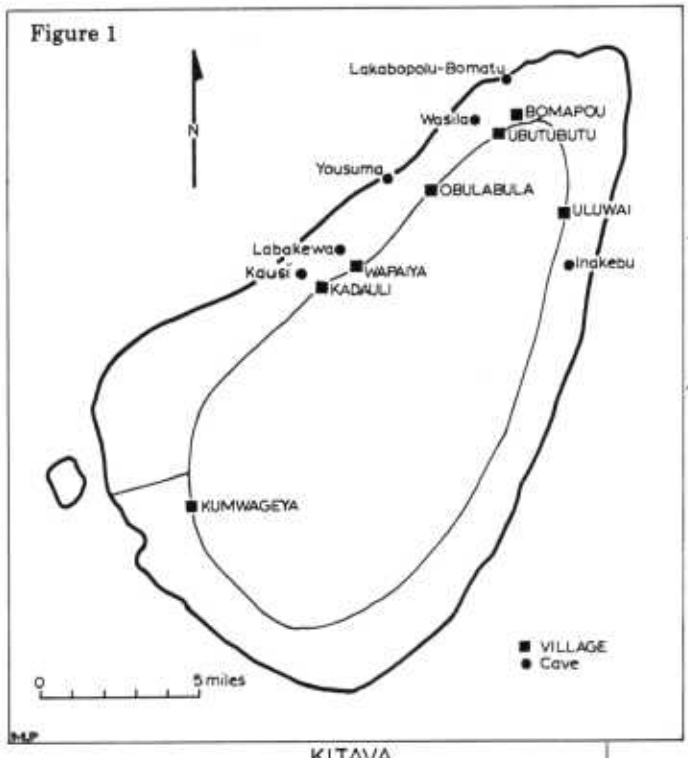
Nearest village: Uluwai. Meaning of name: Unknown. Geomorphic position: Close to the rim of the island, the entrance being on the inner side. Legends: None.

This is a complex cave for the Trobriands. There is one large cavern, several narrow elongate chambers, several high but small chambers, two pits and a few narrow squeezes.

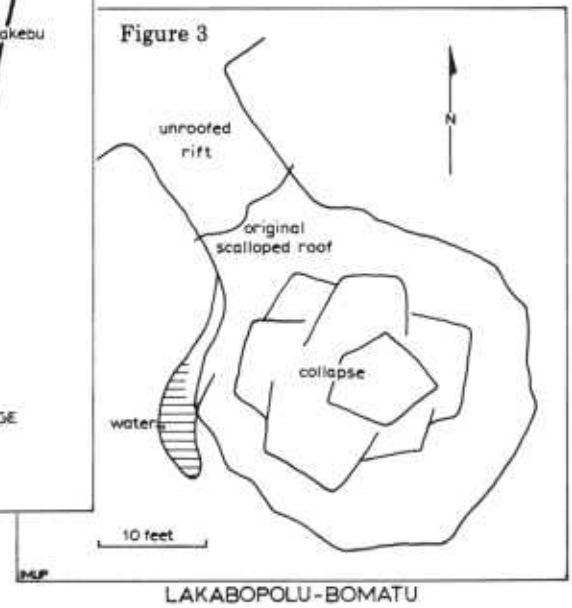
Two circular sinkholes close to the entrance are open to the sky but clearly in line with the cave. Immediately inside the entrance the cave bifurcates. On the western side is an elongate passage, sloping down to the north. In this part of the cave there are fragments of human bones, a bailer shell (Melo sp.), a small shell (Anadara sp.) and a broken shell of Turbo argyrostoma (probably broken for food). This association of bone, bailer shell and small shell is the same as we found in Vakuta (Ollier and Holdsworth, 1969a) and suggests that this part of the cave was once used for funeral practices.

On one side of this chamber there is an elongate pit or rift about ten feet deep, and at the termination there are many shelves and rimstone pool edges indicating a series of falling water levels at some time in the past. The cave is now dry.

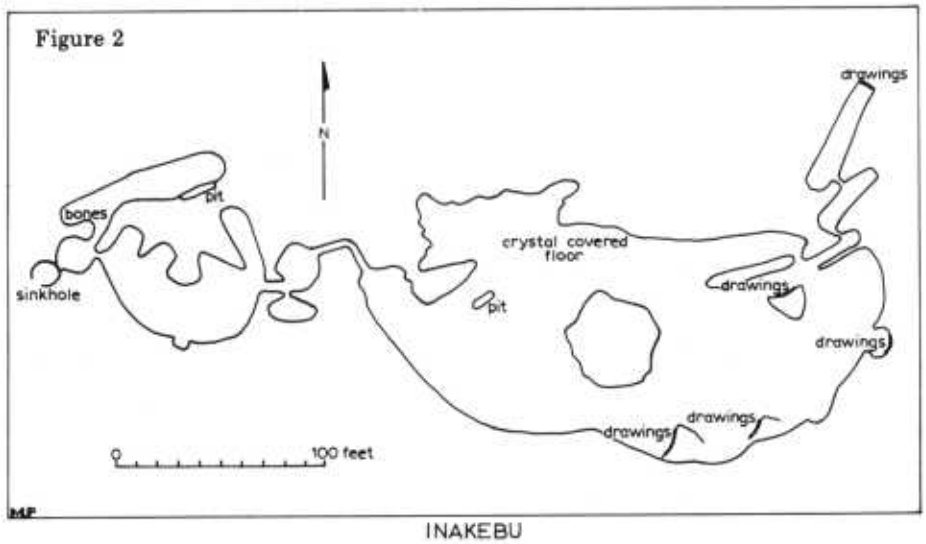
To the right, or east, is a more irregular cave which was probably used also for funerals, although the only evidence we saw was a possible "crypt" or artificial barrier of stones on the eastern wall, and in one place a large clam shell (Tridacna gigas) perched among some stalactites. This might be a modern intrusion; it might be a font, spittoon, or other feature, but since we found a similar clam shell containing human bones in Kuvwau, Kiriwina, we think it is probably a funeral shell.



KITAVA



LAKABOPOLU-BOMATU



INAKEBU

Beyond this cave a small entrance, partially blocked by a boulder, leads to a high chamber with many stalactites. There is a small, minor chamber on the eastern side. Next comes the squeeze passage for 25 feet leading eventually into the main chamber, which is dominantly an irregular phreatic cave.

The walls of this chamber are covered to a great extent with large symmetrical scallops up to three feet across and there are bell-pits (Wilford, 1966) in the roof. The cave is modified by considerable collapse and by speleothem formation. There are several good stalactites and columns. Parts of the floor are carpeted by excellent, pure white, calcite crystals, all cemented together. To the northwest there are two extra chambers, elongated but not parallel, indicating some sort of structural control. There is also a pit in the floor of the main chamber which is elongate along some sort of fracture. It is about ten feet deep, with vertical fluting on the sides (Plate 1).

The feature of greatest interest in this cave is the cave art. It is the first discovered in the Trobriand group and, indeed, there are very few examples in the whole of the Territory of Papua and New Guinea. This cave art will be described in a forthcoming paper (Ollier, Holdsworth and Heers, 1970, in press).

Lakabopolu-Bomatu Cave

(See Figure 3)

Nearest village: Bomapou. Meaning of name: Laka means grave; Bomatu means east wind. Geomorphic position: Close to the sea and not very high above sea level.

Legends: There is a local story that a man out hunting urinated close to this cave and died soon afterwards, so the cave has since been avoided.

The entrance to the cave is through an unroofed rift about ten feet wide, leading to a roughly circular cave. This was a collapse chamber, but the debris has become largely cemented together by flowstone. There are numerous stalactites and stalagmites. Portions of the solutionally shaped roof are preserved, with large symmetrical scallops suggesting a phreatic origin for this cave. It is possible to walk all around the edge of the cave, and partially under the debris. A small pool of water is present on one side of the cave. Snail shells were found in the cave, but no bones, pots or larger shells.

Wasila Cave

Nearest village: Ubutubutu. Meaning of name: Unknown. Wa means in.

Plate 1. Rift with vertical fluting, Inakebu Cave. Photograph: D.K. Holdsworth.

Plate 2. Pottery fragments, Wasila Cave. Photograph: D.K. Holdsworth.

Legends: No legends are attached to the cave and our guide (Nigidageda) discovered it accidentally about a year ago while hunting for cuscus.

Geomorphic position: On the outside of the rim of the island, about two steps down, a few feet below the top of a nearly vertical cliff over 100 feet high. Access is not easy and it would be extremely difficult to find without a guide.

This cave is a small shelf about ten feet deep and up to three feet high, divided by small columns into three chambers, two of which contain pots and bowls. We discovered more untouched pottery in this cave than in any other we have explored. Although many of the pots have broken (Plate 2) - apparently they break in place under their own weight, possibly when moisture softens them - they appear to be all present. We left the pots behind, as it will be much more valuable for a specialist in pottery to examine this find in situ. The pots were large, well ornamented, and apparently of the same kind found associated with other cave burials. There were many human bones in the cave, including skulls, coccyx, ribs and vertebrae. Ribs and vertebrae are not commonly found in the caves so there may be something unusual about the burials in this cave. There was also a wooden tray, which was very desiccated and decomposed, but nevertheless associated apparently with the burials and not a later intrusion. Perhaps the dryness of the locality has enabled wood to survive for a long time, but it does rather suggest that the burials cannot be of very great age - perhaps a few hundred years is all that can be allowed. The pots had turned green and had lost some of their pattern on the exposed sides. The protected sides were fresh and had clearly etched decoration.

Yousuma Cave

(See Figure 4)

Nearest village: Obulabula. Meaning of name: Suma means pregnant. Geomorphic position: Near the sea and close to sea level, backed by steep cliffs. Legends: None.

This is a fairly large cave, but some light penetrates to the inner end. Although there is a good deal of rock-fall, there are also many original cave surfaces which display symmetrical scallops up to about three feet across, indicating phreatic formation. There are also many bell-holes (Wilford, 1966) in the roof. A major joint is visible in the roof of the cave. It appears to have some bearing on the orientation of the cave, although it is not parallel to the main length of the cave. The entrance to the cave is along a fairly low passage, bounded on each side by heaps of debris. The debris must be climbed and then descended to two further chambers, one in line with the entrance and the other evidently a side passage. It seems that the cave was originally a simple branching phreatic passage

which has since been modified by rock-fall, especially along the line of the major joint.

Large numbers of flying foxes and small bats live in the cave and there is a great deal of guano. Natives occasionally visit the cave to hunt flying foxes. We also saw centipedes, spiders and small crabs.

To the north of the entrance passage and about four feet higher is a shelf-like cave with several openings. It has been a funeral cave. A few fragments of pottery and bones were present, and several shells including Strombus luhuanus, Tridacna crocea and Anadara sp., all of which are edible and probably were brought to the cave as food. Also present were four small gastropods of Melania sp. which live in fresh or low salinity water.

Labakewa Cave

(See Figure 5)

Nearest village: Wapaiya. Meaning of name: Unknown. Geomorphic position: Near the crest of the rim of the island on a small cliff facing inland. Legends: See Kausi legend below.

This is a small rock shelter about 12 feet across the front, extending inwards for 19 feet and up to 4½ feet high. Inside there is a line of stones that appears to be the remains of a barrier which formed a crypt, similar to those found on Vakuta (Ollier and Holdsworth, 1969a) and Kiriwina.

This cave was very rich in pots and bones. One intact pot (Plate 3) was taken from this cave by a native and is now in the possession of Mr. G. Heers of Vakuta. Other pottery fragments, many of them large and similar to those in Wasila Cave, were collected by Dr. F. Gerrits early in 1969 for the Port Moresby Museum. Bones are still present, and the cave is remarkable for the concentration of skulls. At least 20 were visible (Plate 4) but the cave is floored by a mixture of soil, bone and pottery fragments and there could well be more skull fragments. The skulls had no peculiar injuries as far as we could determine and the teeth were in remarkably good condition. One shell of Codakia sp. was found.

There is said to be another cave nearby, with no pottery, but we did not have time to visit it.

Kausi Cave

(See Figure 6)

Nearest village: Kadauli. Meaning of name: Unknown. Geomorphic position: Near the rim of the island.

Plate 3. Pot from Labakewa Cave.
Photograph: D.K. Holdsworth.

Plate 4. Concentration of bones, mainly skulls and limb bones, in Labakewa Cave.
Photograph: D.K. Holdsworth.

Legend: Kausi is a bwala (literally means house), that is a place where the ancester of a sub-clan or dala is reputed to have emerged from the ground. A woman called Ikomwaiga emerged from this bwala. She had two sons and two daughters. When they grew up the daughters and the mother made pots, while the brothers fished. On one occasion a boy brought home fish, and was giving it to his mother when the girls grabbed it and ate it raw. The brother became very angry and the girls were so ashamed and frightened that they fled to Labakewa Cave where they hid their pots. They then made the sea disappear by magic and ran to the mountains (probably referring to the Amphlett Islands). The brother followed them, but was caught and drowned when the sea came back, and he was turned into a stone on the shore, which is still there.

Kausi is a collapse depression with overhanging walls forming niches or small rock shelters. A single fragment of pottery and a skull suggests that this cave was itself used once as a funeral cave.

Geomorphology

In our papers on the caves of Kiriwina and Vakuta (Ollier and Holdsworth, 1968a and 1969a), we remarked how we were rather surprised that the caves showed no unusual features due to the special nature of the parent coral, or peculiarities of origin of coral atolls. We had thought we might find original hollows inherited from the coral reefs, or at least tunnels opening on to the sea, but instead we found normal karstic caves. Basically the larger caves were formed as short tunnels fairly close to the watertable, but not opening to the sea, and modified since by varying degrees of collapse and fill; the smaller caves were merely irregular hollows or shelves.

The smaller caves of Kitava are like others of the Trobriands. They can occur at the top or bottom of cliffs, or on irregular ground. However, the larger caves are considerably different, for they present features of deep phreatic formation, i.e. formed below the watertable. The large symmetrical scallops and bell-holes must have been formed when the caves were completely full of water, and the blind valleys, irregular gradients and alternation of large chambers and squeezes in Inakebu all suggest phreatic activity. Yousuma has a simpler shape, but scalloping and bell-pits indicate a phreatic origin.

A number of caves are close to sea level, but they need not have formed at sea level, and perhaps a fall to the present sea level merely exposed caves that were already formed.

The lens of fresh water held in a coral island extends for a considerable depth below sea level. The caves may have formed in this situation, the fresh water possibly passing through caves and emerging eventually as submarine springs.

The caves have been modified later by collapse - structurally controlled in Yousuma - and by secondary deposition. Deposition of stalactite, stalagmite and rimstone pools is still active in many caves, though some small ones like Wasila are now dry.

On Kitava there seemed to be a possibility that we might find several generations of caves associated with the different phases of uplift of the island. This was not found, but the possibility is still present, although less likely now.

On the islands of Kiriwina and Vakuta we made a fairly comprehensive exploration of the caves and probably missed only a few, but on Kitava there are probably many more caves to be found.

The Cave People

In previous papers (See Ollier and Holdsworth, 1968a, 1968b, 1969a and 1969b) we considered who used the caves as burial chambers, and when; who made the pottery; who built the megaliths, which appear to have been funeral monuments originally; what was the relationship between the sub-clans (dala) and their alleged places of emergence from the ground (bwala) which are sometimes caves. On Kitava we have all these questions, plus the additional problem of who painted the cave pictures.

On Kitava there seems to have been a genuine dread of caves until very recently. Some discoveries of bones and pots were a surprise to the natives themselves, as was the discovery of cave paintings. The present inhabitants do not seem to be connected directly with either the art or the burials. The pottery found in the caves of Kitava is of a similar style and age to that found on other islands, quite different from that of the present day, and of unknown origin. A number of megaliths are present on Kitava which at one time were probably funeral places. For some the natives have no story whatever, while other megaliths are used for magical purposes which seem to be of secondary origin. Some of the Kitava caves are bwala or emergence holes. We have discovered no association between the cave pictures and other features; it appears that cave burials were made in the same cave that the pictures are in, but in a different chamber, and quite possibly by different people.

All these things suggest the possibility that the present inhabitants are not the people who did all the things connected with the caves, but possibly displaced an earlier (though somewhat similar) people.

The only clue so far as to the time of these postulated former people comes from the dala lines. Each sub-clan can trace its ancestry verbally from mother to mother back to the woman who first emerged from the ground to found the dala. This takes about 25 generations, or perhaps 500 years.

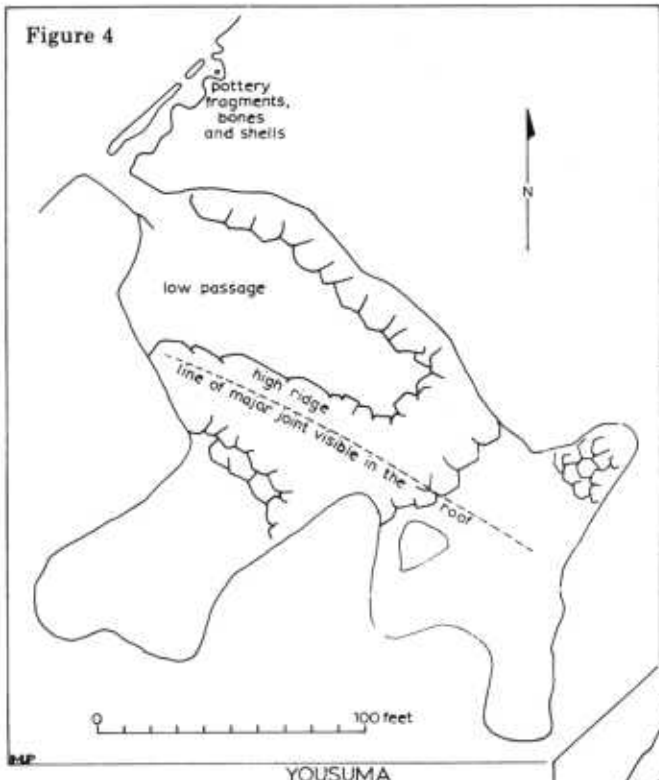


Figure 4

YOUSUMA

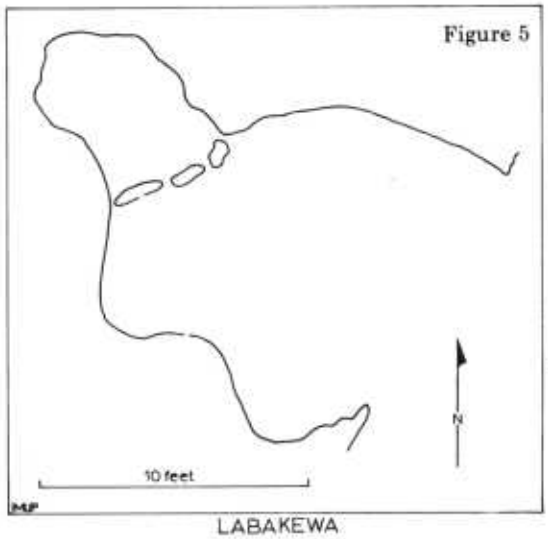


Figure 5

LABAKEWA

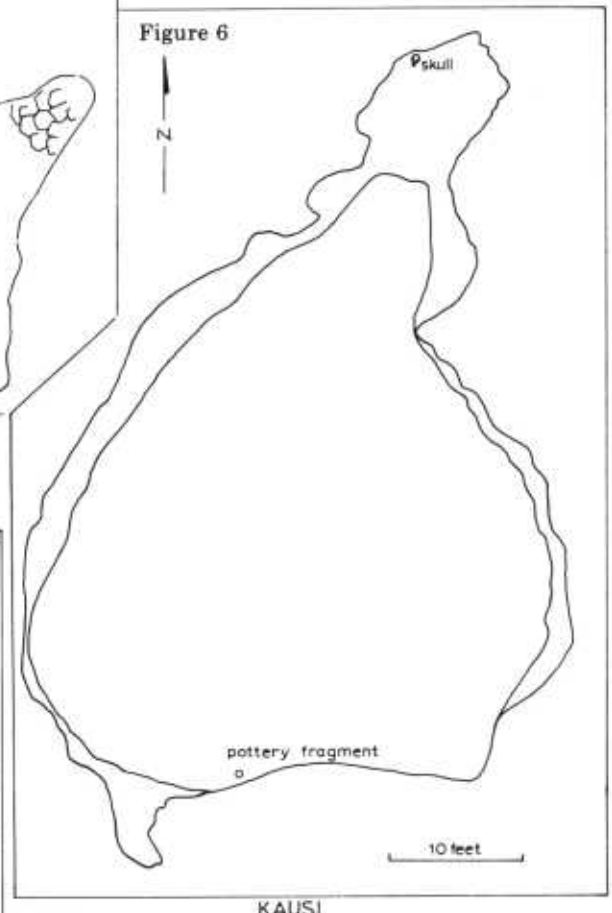


Figure 6

KAUSI

Could the "emergence from the ground" refer in reality to the arrival of the present inhabitants (by boat) who wiped out any previous occupants, perhaps 500 years ago?

There is a large enough sample of bones for an expert to work out the sort of people who are buried in the caves, and dates could be obtained from bone, shell and even wood. Investigations of the pottery in stratified sites will also give some clue eventually as to the date of the cave burials. The caves of Kitava provide a lot of work and hold out promise of a lot of discoveries for future investigators.

Acknowledgments

We gratefully acknowledge the help given to us by Mr. C. Single, Mr. and Mrs. T. Ward, Dr. F. Gerrits, and specially Mr. G. Heers who first discovered the cave art in Inakebu and whose fluency in the native language was of immense value to our expedition.

References

OLLIER, C.D., HOLDSWORTH, D.K. 1968a : Caves of Kiriwina, Trobriand Islands, Papua. Helictite, 6 (4) : 63 - 72.

OLLIER, C.D., HOLDSWORTH, D.K. 1968b : A Survey of a Megalithic Structure on Kiriwina, Trobriand Islands. Arch. and Phys. Anth., 3 (2) : 156 - 158.

OLLIER, C.D., HOLDSWORTH, D.K. 1969a : Caves of Vakuta, Trobriand Islands, Papua. Helictite, 7 (3) : 50 - 61.

OLLIER, C.D., HOLDSWORTH, D.K. 1969b : Megaliths of Vakuta, Trobriand Islands, Papua. Arch. and Phys. Anth. (in press).

OLLIER, C.D., HOLDSWORTH, D.K., HEERS, G. 1970 : Cave Paintings from Kitava, Trobriand Islands, Papua. Helictite (in press).

WILFORD, G.E. 1966 : "Bell Holes" in Sarawak Caves. Bull. Nat. Spel. Soc., 28 (4) : 179 - 181.

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A CHECK ON THE RADIOCARBON DATING OF DESICCATED THYLACINE (MARSUPIAL "WOLF") AND DOG TISSUE FROM THYLACINE HOLE, NULLARBOR REGION, WESTERN AUSTRALIA

D. MERRILEES

Western Australian Museum, Perth

Abstract

A "modern" (180 + or - 76 years B.P.) radiocarbon date (N.S.W. 42) on desiccated rabbit flesh from Thylacine Hole (N63) suggests that dates N.S.W. 28c (4,650 + or - 153 radiocarbon years B.P.) on thylacine flesh and hair and N.S.W. 30 (2,200 + or - 96 radiocarbon years B.P.) on dog (dingo) flesh from the same cave are reliable within limits discussed.

Introduction

Radiocarbon dates on the furred but desiccated carcase of a thylacine, and on a less well preserved dog (dingo) carcase from Thylacine Hole (N63, 31°42'S, 127°44'E) are reported by Lowry and Merilees (1969). These dates (N.S.W. 28c on the thylacine and N.S.W. 30 on the dog) are 4,650 + or - 153 years B.P. and 2,200 + or - 96 years B.P. respectively. A greater age for the better preserved thylacine was unexpected, and accordingly a desiccated rabbit carcase was collected from the same cave and submitted for radiocarbon dating as a check on the reliability of the somewhat unusual material employed for dating, since the approximate time of first arrival of rabbits in the Thylacine Hole district is known.

The radiocarbon age of desiccated flesh from the rabbit (Western Australian Museum specimen 68.11.117) is 180 + or - 76 years B.P. (N.S.W. 42 - personal communication, V. Djohadze, Department of Nuclear and Radiation Chemistry, University of New South Wales.)

Discussion

European rabbits (Oryctolagus cuniculus - Eutheria, Lagomorpha) were introduced into Australia at least as early as the first permanent European settlement, but feral rabbits do not appear to have established themselves in considerable numbers until some 70 years later (Ratcliffe and Calaby, 1963; Rolls, 1969). Before 1890, feral rabbits appear to have begun a westward expansion from South Australian foci towards the southern margin of Western Australia, and even at this late date, some of this expansion may have resulted from deliberate introduction of young rabbits to

places suitable to them by European colonists migrating westward from South Australia (Rolls, 1969).

By 1896, reports of rabbit incursions into Western Australia along a coastal strip south of the Nullarbor Plain had been received by the Western Australian Government, and an expedition led by A. Mason was despatched to investigate these reports (Mason, 1897). According to Mason, rabbits were indeed present as far west as Twilight Cove; they were found not more than 17 miles north of the sea near Eucla, but at least 20 miles north of the sea about 120 miles west of Eucla. Thylacine Hole is about 68 miles west of Eucla and 29 miles north of the sea. Thus it is probable that rabbits had reached the vicinity of Thylacine Hole before 1896, but probably (Ratcliffe and Calaby, 1963) not many years before this.

I accept 1895 as the earliest likely date for rabbit specimen 68.11.117, and its latest likely date as 1965, a few years before it was collected by Mrs. J.W.J. Lowry in 1968.

Polach and Golson (1966) recommend a procedure for expressing radiocarbon age determinations as conventionally reported in terms of probable (95.45% probable) age ranges in calendar years. The reported radiocarbon age is increased by 3% (to allow for recent redetermination of the half-life of the radioisotope C-14), reported errors are increased if necessary to a minimum of 100 years (to take account of greater accuracy in laboratory measurement than warranted by "general uncertainties applying to the method", such as those discussed by Stuiver and Suess, 1966, or Scholl, Craighead and Stuiver, 1969) and taking two standard deviations (twice the reported error) before and after the reported date. Adopting this recommendation, radiocarbon date N.S.W. 42 would be expressed as 185 + or - 200 years B.P. (Before Present). "Present" means A.D. 1950, and there is no suggestion that in the rabbit tissue sampled, C-14 concentration exceeded the modern reference standard. Hence rabbit 68.11.117 probably died at some time within the range A.D. 1565 to A.D. 1950, so far as the radiocarbon age estimate shows.

Contamination by radioactively "dead" carbon in limestone dust adhering to the specimen cannot account for the possibility of an early age (before 1895) for the rabbit sample submitted, because it, like the thylacine sample forming the basis of date N.S.W. 28c, was treated with hydrochloric acid. Thus the possibility perhaps should be considered that rabbits were introduced into Australia before the dates at present documented, for example by the survivors from the Dutch vessel Vergulden Draak, wrecked on the west coast of Australia in 1656 (Heeres, 1899).

Even if this remote possibility be taken into account, the radiocarbon age estimate for rabbit specimen 68.11.117 is consistent with the usual concept of the Australian rabbit as a European introduction made in modern

times. If the radiocarbon age estimate on desiccated rabbit tissue is of the right order, it seems likely that similar estimates on similar materials from other mammals in the same locality are also of the right order. Thus it is reasonable to accept the probably age range of the Thylacine Hole dog as 2,466 to 2,066 years B.P. (from date N.S.W. 30) and of the thylacine as 5,096 to 4,484 years B.P. (from date N.S.W. 28c).

By extrapolation, it is reasonable also to accept the probable age range of a thylacine from Murra-el-elevyn Cave (N47), also in the Nullarbor region, described by Partridge (1967) to be 3,578 to 3,178 B.P. (from date GaK 693).

According to the tests of significance given by Polach and Golson (1966), the differences in age of the Thylacine Hole dog and thylacine specimens and the Murra-el-elevyn thylacine specimen discussed above are highly significant.

Acknowledgments

I am grateful to Mr. J.N. Jennings (Australian National University) for the initial suggestion that a desiccated rabbit from Thylacine Hole be dated, to Mrs. J.W.J. Lowry for collecting a suitable specimen, and to Messrs. H. Polach (Australian National University) and J.L. Bannister (Western Australian Museum) for their criticisms of an earlier draft of this report.

References

HEERES, J.E. 1899 : The Part Borne by the Dutch in the Discovery of Australia 1606 - 1765. Luzac, London.

LOWRY, J.W.J., MERRILEES, D. 1969 : Age of the Desiccated Carcase of a Thylacine (Marsupialia, Dasyuroidea) from Thylacine Hole, Nullarbor Region, Western Australia. Helictite, 7 : 15 - 16.

MASON, A. 1897 : Report of an Expedition in the South-Eastern Portion of Western Australia to Inquire into a Reported Incursion of Rabbits. Government Printer, Perth.

PARTRIDGE, J. 1967 : A 3,300 Year Old Thylacine (Marsupialia, Thylacinidae) from the Nullarbor Plain, Western Australia. Journal of the Royal Society of Western Australia, 50 : 57 - 59.

POLACH, H.A., GOLSON, J. 1966 : Collection of Specimens for Radiocarbon Dating and Interpretation of Results. Australian Institute of Aboriginal Studies Manual 2.

RATCLIFFE, F.N., CALABY, J.H. 1963 : Rabbit entry in The Australian Encyclopaedia. Grolier Society, Sydney.

ROLLS, E.C. 1969 : They All Ran Wild. Angus and Robertson, Sydney.

SCHOLL, D.W., CRAIGHEAD, F.C., STUIVER, M. 1969 : Florida Submergence Curve Revised : Its Relation to Coastal Sedimentation Rates. Science (American Association for the Advancement of Science), 163 : 562 - 564.

STUIVER, M., SUESS, H.E. 1966 : On the Relationship Between Radiocarbon Dates and True Sample Ages. Radiocarbon, 8 : 534 - 540.

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SMALL CAVITIES IN THE NULLARBOR PLAIN

D.C. Lowry's latest contribution to the geomorphology of the Nullarbor Plain - "The Origin of Small Cavities in the Limestone of the Bunda Plateau, Eucla Basin", Geol. Surv. W. Australia Ann. Rept. for 1968, 1969 : 34 - 37, is a valuable addition to our knowledge of the area and warrants discussion.

Lowry classifies the small cavities in the Western Australian part of the Plain into five categories.

(1) Anastomosing tubes developed in fracture surfaces.

Chiefly between 5 and 50 feet below the surface, these are up to 4 inches in diameter, approximately constant for each tube. They may cross one another and are often filled with clay, lithified to differing degrees. Tree roots are occasionally found in them. Lowry regards them as due to plant secretions corroding the limestone around growing roots. I had not distinguished them genetically from the whole range of small-scale cavities close to the surface of the Plain which I attributed to true phreatic solution (Jennings, 1961).

(2) Surface pitting.

These are circular openings in the walls of dolines, 1 to 6 inches across but not much greater in depth. They are attributed by Lowry to salt crystallisation (exsudation).

(3) Irregular cavities with smoothly curving walls.

Also circular tubes, these are variable in diameter lengthwise and up to 20 inches in diameter. They are not concentrated in planes of weakness and occur at various levels from 10 to 140 feet down. They may contain clay. The author admits the possibility of phreatic solution for them but also maintains that they may be partly of vadose origin as a result of water seeping along clay-filled tubes of a nature not explicitly stated.

(4) Horizontal flat-bottomed cavities.

Up to 2 feet wide and 1 foot high, and usually filled with horizontally bedded calcite, these cavities occur in flat zones parallel to the surface, mostly some distance below it but at times as near as 60 feet. They are attributed to control of solution by bedding or by perched water-tables such as those occurring beneath dongas near Rawlinna.

(5) Horizontal rectilinear passages.

Smooth, circular passages 2 to 10 feet in diameter, they may form networks in a horizontal plane or occur above one another in joint planes. Some contain bedded red clay. Recorded occurrences lie between 20 and 250 feet above the present watertable. These are regarded by Lowry as due to true or shallow phreatic solution; in the latter case they refer to former watertables. Because of the extreme flatness of the present watertable, Lowry argues that even large increases in vadose water in colder or rainier climates could not conceivably raise it to the levels required by these small phreatic passages. Instead he attributes them to higher sea levels. The highest ones might then belong to an early Pleistocene "Sicilian" sea level or to upper Tertiary sea levels.

Some of the difficulties and corollaries attaching to these interpretations will now be considered.

(1) There can be little doubt but that some of the shallow tubes are due to tree roots. I have myself seen such effects in New Guinea, Malaya, Sarawak, the Limestone Ranges of West Kimberley (Jennings and Sweeting, 1963), and in the southwest of Western Australia (Jennings, 1968). In the last area there are living roots nearly 200 feet below the surface in Lake Cave. Whether this process is of much importance in the Nullarbor is not so certain.

A. For no other karst has a very important role been attributed to tree roots. Today, the Nullarbor Plain as a vegetation region lacks trees and the wetter coastland carries no more than scrub. Nor has any good evidence yet been adduced for higher vegetation than scrub in the Plain during past climatic periods of more effective precipitation. The preatophytes of temperate and tropical rainforests must surely have done more geomorphic work of this nature in associated karst. No such claim has been made for rainforest karsts, and my own experience in such areas excludes general close-set perforation near the surface similar to that which led me to postulate a "zone of intense phreatic preparation" in the Plain. There is then an inherent improbability about tree roots being very much more important in semi-arid to arid conditions.

B. Bedding-plane anastomoses often make X-junctions as well as Y-junctions and the former junctions therefore cannot be used as criteria for tree root origins.

C. Nor can clay fills with differing degrees of lithification be regarded as critical. Progressive washing down or subsiding of surface clay or of insoluble limestone residues can fill phreatic tubes as well as tree root cavities. Indeed Bretz, whom Lowry cites in this connection, regards clay residue fills as an almost inevitable succession to phreatic solution, though this extreme view has not found general acceptance.

D. Lowry regards tree root activity as confined to planes of weakness. His Plate 13A appears to illustrate a tree root penetrating massive rock and I have observed similar occurrences in the Elimbari Range, New Guinea, for instance. I gave the epithet "intense" to my "zone of phreatic preparation" precisely because the tubes were not confined to bedding or joint planes. To attribute these other tubes to tree roots is logical, but greatly exacerbates the problem set out in 1A above, namely that more is demanded for tree roots in a semi-arid climate than has been claimed in more favourable climates.

E. The "spongework" of Bretz and his bedding- and joint-anastomoses are not fundamentally different but can grade into one another. If true phreatic conditions persist, the former will develop from the latter. For example, in the level of horizontal development in the caves near Augusta in the south-west of Western Australia, every stage is recognisable from small tubework, sometimes preferentially developed in aeolian crossbeds, to quite large phreatic cavitation.

Generally, though more or less horizontal bedding-plane anastomoses often consist of half-tubes in the upper bed only, this is not a necessary condition. For example, the limestone may not have sufficient impurities to cause this. Certainly this condition will not apply to steeply inclined tubes, be they in joints, cleavage or bedding planes, or not structurally localised.

Such considerations indicate that distinction between tree root tubes, vadosely modified tree root tubes, phreatic tubes and spongework may not be so straightforward as the author's classification might suggest.

(2) Because the climatic conditions seem to be favourable both to salt weathering at the surface and underground, surface pitting in doline walls may give rise to more pseudo-phreatic features than tree root growth. Nevertheless, cavernous weathering in the deep caves differs from the doline features in that the whole rock surface is affected by mechanical disintegration; even the narrow rims left between hollows are rounded off in this way. Also, the hollows are large and shallow and there is a good deal of uniformity in shape and size in a given area. Compared with them, surface pitting in some dolines such as Paratippa leaves plenty of untouched surface between the hollows which vary very much in size, penetrate more deeply in proportion, and often there are sharp corners where pits intersect walls. There is the possibility that lithological differences between the Nullarbor Limestone on the one hand and Wilson Bluff and Abrakurrie Limestone on the other might cause such variation, though the fact that solution tubes develop well in the latter two limestones casts doubt on this. Perhaps some of the doline features are phreatic tubes modified by salt crystallisation. This is the idea I have had of Koonalda and Wigunda dolines, for example.

(3) The irregular cavities with smoothly curving walls and of changing cross-section along their length are the critical elements in relation to the concept of a "zone of intense phreatic perforation". If they are due solely to vadose water movement, it is difficult to see why those in joints and other planes of weakness were not preferentially enlarged and how their irregularity in diameter was achieved. If they are regarded as due to vadose enlargement of clay-filled tubes already present, the implication seems to be that the primary tubes were due to tree root growth. With this view the difficulty discussed above under 1A remains to be resolved. I am, therefore, still inclined to regard them as phreatic in origin.

(4) With regard to the category of calcite-filled horizontal flat-bottomed cavities, it must be noted that calcite fills are not restricted to such cavities. For example, in White Wells Cave, bedded calcite fills occur in three-dimensional mazes of type (3) cavities; unfilled cavities of the same type are found in contiguity.

(5) Lowry's case for a shallow phreatic origin for the horizontal rectilinear passage networks, with which I agree, amplifies that of Hunt (in Jennings, 1967, and Hunt, 1970). I did not encounter features of this type in the Nullarbor till 1963 in Firestick Cave and it was impossible to incorporate reference to them in Jennings (1963). The further argument that the large watertable shifts involved must result from sea level changes rather than from climatic change because the present watertable near the coast is extremely flat, is a strong one.

The author's reference to an early Pleistocene "Sicilian" high sea level implies eustatic sea level change. Deperet's height for the Sicilian is 90 - 100 m (300 - 330 feet); in better agreement with the highest of these networks, that at 250 feet above the present watertable in Kestrel Cavern No. 1, is the lower limit given by Zeuner, namely 80 m (260 feet). Such a eustatic shift must involve the drowning of the southeast corner of the Plain from Koonalda Cave eastwards. No shorelines or marine fossils have yet been found to confirm this, though there is an area below 200 feet north of the Head of the Bight which has a smooth, featureless photopattern different from the patterns found elsewhere in the Plain (Jennings, 1967). Bauer's claim for a eustatic marine surface in Kangaroo Island at 250 - 400 feet is also relevant (Bauer, 1961). If then we accept for the sake of argument that the Kestrel Cave phreatic passage network implies a Sicilian sea level, there is the corollary that, in the southeast, phreatic conditions must have reached right to the surface of the Plain. Some of the differences between Lowry's and my previously published views might then be due to the fact that I chiefly worked in this lower southeast and he in the higher parts in Western Australia. Nevertheless, it must be remembered that many authorities - e.g. Flint (1966) - are sceptical about higher eustatic levels above the Tyrrhenian (+ 30 - 40 m), because tectonic and eustatic effects have rarely been separated.

To sum up, much of what Lowry has written in revision of my initial assessment of near-surface micro-cavitation in the Plain seems valid; it may not be so general as I claimed and other features than the phreatic one have been at work to produce them. Nevertheless, there remains the need to assess more fully the operation of these different mechanisms and to explore the possibility that there are regional differences in the nature of this aspect of the geomorphology of the Nullarbor.

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References

BAUER, F.H. 1961 : Chronic Problems of Terrace Study in Southern Australia. Zeit. Geomorphologie, Suppbnd 3 : 57 - 72.

FLINT, R.F. 1966 : Comparison of Interglacial Marine Stratigraphy in Virginia, Alaska and Mediterranean Areas. Amer. J. Sci., 264 : 673 - 684.

HUNT, G.S. 1970 : The Origin and Development of Mullamullang Cave N37, Nullarbor Plain, Western Australia. Helictite, 8 (1) : 3 - 26.

JENNINGS, J.N. 1961 : A Preliminary Report on the Karst Morphology of the Nullarbor Plains. Cave Exploration Group (S. Aust.), Occ. Pap. 2.

JENNINGS, J.N. 1963 : Some Geomorphological Problems of the Nullarbor Plain. Trans. Roy. Soc. S. Aust., 87 : 41 - 62.

JENNINGS, J.N. 1967 : The Surface and Underground Geomorphology in Caves of the Nullarbor. Eds. J.R. Dunkley and T.M.L. Wigley : 13 - 31. Speleological Research Council Ltd., Sydney.

JENNINGS, J.N. 1968 : Syngenetic Karst in Australia in Contributions to the Study of Karst, P.W. Williams and J.N. Jennings. Dept. Geog. Pubs. G/5, Australian National University, Canberra.

JENNINGS, J.N., SWEETING, M.M. 1963 : The Limestone Ranges of the Fitzroy Basin, Western Australia. Bonner Geogr. Abh., Heft 32.

LOWRY, D.C. 1969 : The Origin of Small Cavities in the Limestone of the Bunda Plateau, Eucla Basin. Geol. Surv. of West. Aust. Annual Rpt. for 1968 : 34 - 37.

GERARD PLATTEN 1899 - 1970

The editors of Helictite were sad to learn of the death of Gerard Platten, editor and publisher of The British Caver, on 20 March 1970. Mr. Platten started this independent caving journal in the 1930s and published thousands of pages of reports, references and articles on world-wide speleological activities, particularly those of the United Kingdom. He also built up an impressive caving library of books and exchanged publications which he placed in the Bath Museum.

Despite ill-health during the past few years, he managed to keep the BC in production with the assistance of a succession of helpers. Australian cavers will miss his journal and its individualistic style and approach. I personally shall miss the exchange of letters and Christmas cards which we began about 15 years ago. - E.A. Lane.

A B S T R A C T S

SIXTH, SEVENTH AND EIGHTH ANNUAL REPORTS ON BAT-BANDING IN AUSTRALIA, JULY 1964 TO JUNE 1967. By D. Purchase. CSIRO Div. of Wildlife Res. Tech. Pap. No. 17 : 16 pp. 1969.

During the period 1 July 1964 to 30 June 1967, a total of 17,227 bats of 11 species were banded, all Australian States being represented. The bent-winged bat, Miniopterus schreibersii (Kuhl), accounted for 15,602 of these. The period was notable for several long-distance recoveries, including the movement of a male bent-winged bat from Glen Fernleigh Cave (north-eastern New South Wales) to Panmure Cave (western Victoria), a distance of 780 miles. Other movements of bent-winged bats illustrated the interchange and intermingling of individuals from the three populations derived from the maternity colonies at Wee Jasper and Bungonia (N.S.W.) and Nowa Nowa (Vic.). Appendices include a table of numbers of each species banded and recovered during the period under review, plus collective figures for the period 1957 - 67. Full data is given for 40 selected recoveries, together with brief comments on their significance. A list is provided of 68 banding sites used for the first time during the review period. - E.A.L.

ABORIGINAL CAVE PAINTINGS AND ROCK MARKINGS AT INGALADDI ROCK SHELTER, WILLEROO, NORTHERN TERRITORY OF AUSTRALIA. By Charles P. Mountford and Erhard J. Brandt. Rec. S. Aust. Mus., 15 (4), 1968 : 679 - 692.

This paper records cave paintings and rock markings on the walls and ceilings of a sandstone outcrop at Willeroo, 70 miles from Katherine in the Northern Territory. The designs are illustrated, the probable techniques of production are discussed and, where applicable, their origins and meanings noted. - A.M.R.