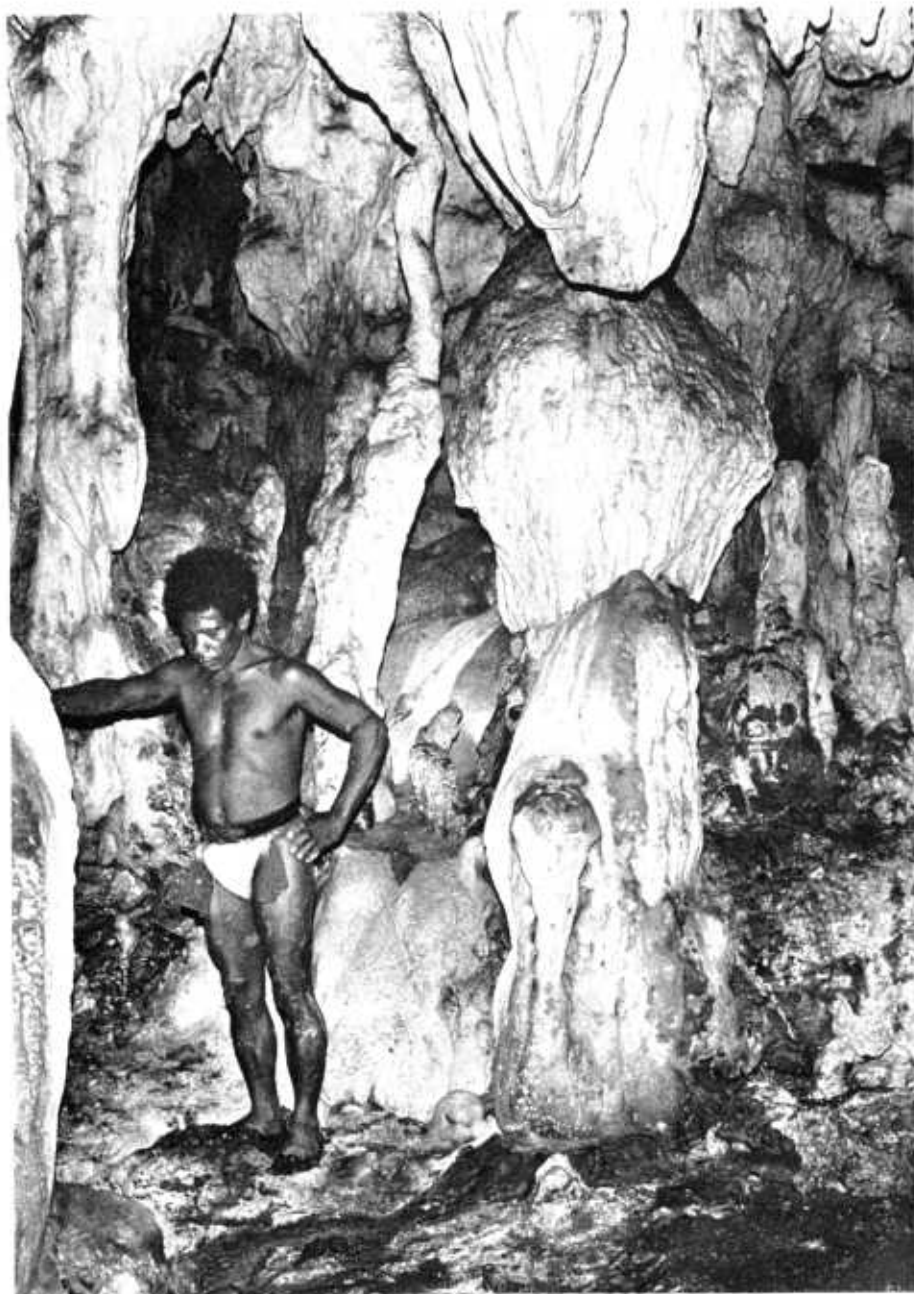


Helictite

JOURNAL OF AUSTRALASIAN CAVE RESEARCH

Native guide Kunagesi
in Tumwalau Cave,
Kiriwina, the largest
island of the Trobriands
lying between New
Guinea and New Britain.



" HELICTITE "

Journal of Australasian Cave Research

Edited by Edward A. Lane and Aola M. Richards

VOLUME 6, NUMBER 4

Published Quarterly

JULY, 1968

CONTENTS

<u>Helictite</u> to Vary Publication Dates and Subscription.....	p. 62
Caves of Kiriwina, Trobriand Islands, Papua..... C.D. Ollier and D.K. Holdsworth	p. 63
<u>Höhlenkunde</u> (Book Review).....	p. 72
Two Small-Scale Solution Features of Limestone Outcrops in Sarawak, Malaysia (Abstract).....	p. 74
The Need for Preservation of Aboriginal Cave Art (Review).....	p. 74
Aboriginal Cave Paintings, Mountain Creek Waterhole, St. Vidgeon, Northern Territory of Australia (Review).....	p. 75
Underground Water Movements in the Lobster Rivulet-Mole Creek Divide, Tasmania (Abstract).....	p. 75
Ordovician Conodonts from New Zealand (Review).....	p. 76
The Geology of Sarawak and Sabah Caves (Review).....	p. 76
The Use of Ethyl Mercaptan in Caves (Abstract).....	p. 78
The Biology, Origin, and Adaptation of <u>Miniopterus australis</u> (Chiroptera) in New South Wales (Abstract).....	p. 78
Across New Guinea from the Fly to the Sepik (Book Review).....	p. 79
The Geographical Distribution of Australian Cave-Dwelling Chiroptera (Abstract).....	p. 79
Notes on the Biology of Two Species of Rhabdophoridae (Orthoptera) in Tasmania (Abstract).....	p. 80

Fauna of the Dark Cave, Batu Caves, Kuala Lumpur, Malaysia
(Abstract).....p. 80

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A MESSAGE TO SUBSCRIBERS

Publication Dates

As from Volume 7, Number 1, publication dates for Helictite will be changed and all four issues of forthcoming volumes will fall within the same calendar year. Number 1 will be published in January; Number 2 in April; Number 3 in July; and Number 4 in October. No normal issue will be published in October, 1968 - the previous starting date for each volume.

Index, Volumes 1-4

The usual October, 1968, issue will be replaced with a special issue (running very late) - the Cumulative Index, Volumes 1-4. This issue will be numbered Volume 4, Number 5, and will be posted on publication to all who have paid for the Index in advance. Others may obtain copies at 50¢.

Subscription, Volume 7

The publishers are forced by repeated rises in costs to increase the annual subscription to A\$2.40 (60¢ an issue). Prices of casual copies will remain unchanged. Overseas subscribers please add A20¢ to cover additional postage. Subscriptions paid in advance at the old rates will be honoured.

This is the first subscription increase for six years and has been thrust upon Helictite by successive increases in postage rates, a 2½% increase in Sales Tax, increases in costs for paper, envelopes, blocks, off-set plates, printing, etc. All receipts from Helictite are put back into the Journal and we hope that this modest increase will allow us to maintain our high standards of production.

THE EDITORS

CAVES OF KIRIWINA, TROBRIAND ISLANDS, PAPUA

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Introduction

The Trobriand group of coral islands is situated 100 miles off the northeast coast of Papua and north of the D'Entrecasteaux Islands. The largest island, Kiriwina, is 30 miles long and 12 miles across at its widest point.

The authors visited Kiriwina for two separate periods of one week in 1967 and 1968 to undertake a phytochemical survey and a reconnaissance exploration of the caves. They believe that they explored all the sizeable caves from Wawela north.

A DC-3 aircraft of Papuan Airlines operates a weekly flight between Port Moresby and Losuia, the Administration centre. Accommodation is provided on the island at the Trobriand Hotel, conducted by Mr. T. Ward, whose two trucks are used for local transportation on roads engineered by the US Army during World War II.

The population of Kiriwina, about 12,000 people, presents a very great variety of physical types but all speak Kiriwini, and neither Pidgin nor Motu are much used. The Trobrianders are famous for their woodcarving, and their social customs are well-known from the writings of the anthropologist B.K. Malinowski. Until recently they had changed little from the state he described in the 1920s. During the war they developed a taste for chewing gum, known always as P.K., and now a useful barter item with children. Traditional dress is a chunky grass miniskirt for women and a pubic leaf of pandanus for men, but in the past two years there has been a considerable shift towards dingy, European cast-off clothing.

The most accurate map of the island is an Admiralty chart, but for details of villages and interlinking foot-tracks the authors used an old US Army map. Villages are moved often to more fertile positions, while retaining their former names. Other difficulties were encountered in the spelling of village and place names, which vary considerably on different maps and in journals. The authors took considerable pains to obtain accurate spellings of the native names from their guides, cross-checking whenever possible with Administrative records, but it seems that Kiriwina spelling is not yet standardised.

Guides were recruited from local villages. Communication sometimes was

difficult, though teenagers with some schooling usually had a fair grasp of English. Payment in cash was rarely appreciated and stick tobacco with newspaper proved more welcome. Guides preferred to be paid just before reaching their home village, otherwise they were obliged to give most away to their eager neighbours. The gift of a stick or two of tobacco to the village chief proved diplomatic.

Caves were surveyed using 100 ft tape and compass. Human bones, wherever found, were photographed and left undisturbed for later anthropological and archeological research. Most caves contained fresh, clear water and villagers utilise small caves for their normal water supplies. The grass-skirted women and girls often walk for miles with an assortment of water containers on their heads. A concrete pad outside one cave was evidence that the US or other Allied Force pumped water from the cave during the war.

Selai Cave

(Nearest village, Labai. See Plate 1 and Figures 1 and 2).

This appears to be a sacred cave, and Mr. Ward estimates that perhaps only half a dozen Europeans had been in the cave previously. At one time the natives had decided, or had been advised by a misguided contact to ask for two hundred dollars to show people over the cave. Unless you share the superstition of the islanders themselves, it is certainly not worth this amount.

The cave is said to be the place from which the original Trobriand woman emerged. We did not discover the origin of the men. Inside the cave is a featureless and insignificant stalagmite which is said to be the "baby", left behind by the first woman. It falls far short of the imaginary personalities common in many show caves, but perhaps when the legend started it had a greater resemblance to a baby than now and continued accretion may have spoiled the image.

The cave is difficult to depict on a map, being roughly spiral. The entrance leads into a large chamber, from which one route leads down to a lake, and another up to a bone passage which is, in part, directly above the lake. Much of the cave is due to collapse, and the long straight north-western wall is the side of straight collapse tunnel of arcuate cross section.

This cave contains many small bats, living in a chamber over the water, and in the water a black crayfish was seen (known locally as kiu) and 12-inch long eels (known as tobuadi).

The guides were somewhat unwilling to show us the bone passage, though other bone caves we had seen were treated with no respect at all. Some of

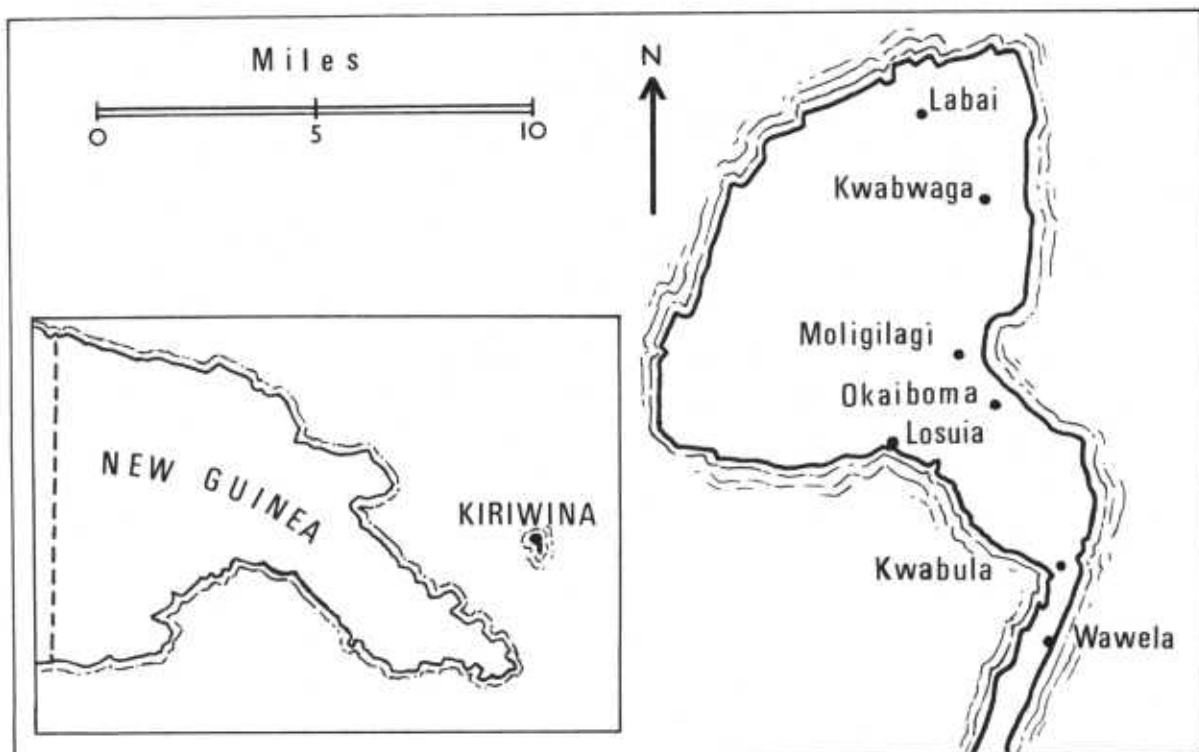


Figure 1 : Northern portion of Kiriwina, Trobriand Islands.

the skulls showed holes and double holes. The bones, especially the teeth, looked comparatively fresh, but a few bones were found stuck together by calcrete.

A large clam shell was present in the cave. There is a legend, told by our guides, that in ancient times 13 men were lost in this cave and never returned. The same legend appears to be attributed also to Origiveka Cave.

Origiveka Cave

(Nearest village, Kwabwaga. See Figure 1).

This is probably the largest cave on the island, and one of the most difficult to negotiate. We were not able to survey it. A few ropes and helmets are recommended for future exploration. The cave is probably at least 600 feet long and over 100 feet wide. The ceiling is high, and the floor is covered by fallen blocks, some of which are the size of houses. There are many bats, and there is a stream or long pool on the eastern side. Some large stalactites and columns are present, but decoration is not the dominant feature of this cave.

There is said to be a hidden passage leading from somewhere on the left side of the entrance to a very extensive cave, and it is said that an early missionary spent a whole day exploring this cave. The legend of the 13 men who entered the cave and never returned is also attributed to this cave.

A more modern story is that the American forces stored materials in the cave, and one version is that the entrance may have been blasted to hide their cache, and incidentally possibly blocking the entrance to the extensive passages. It is possible that when the Americans left they hinted about useful things left inside, because a craze developed for digging in the cave. When one man dreamed of digging with a magic hoe and finding the treasure, something very like a cargo cult developed, and the Administration was obliged to stop all digging in the cave.

Our limited exploration failed to find any sign of blasting, of a hidden passage, of any cargo, or even any indication of much digging.

Tuweria Cave

(Nearest village, Moligilagi. See Figures 1 and 2).

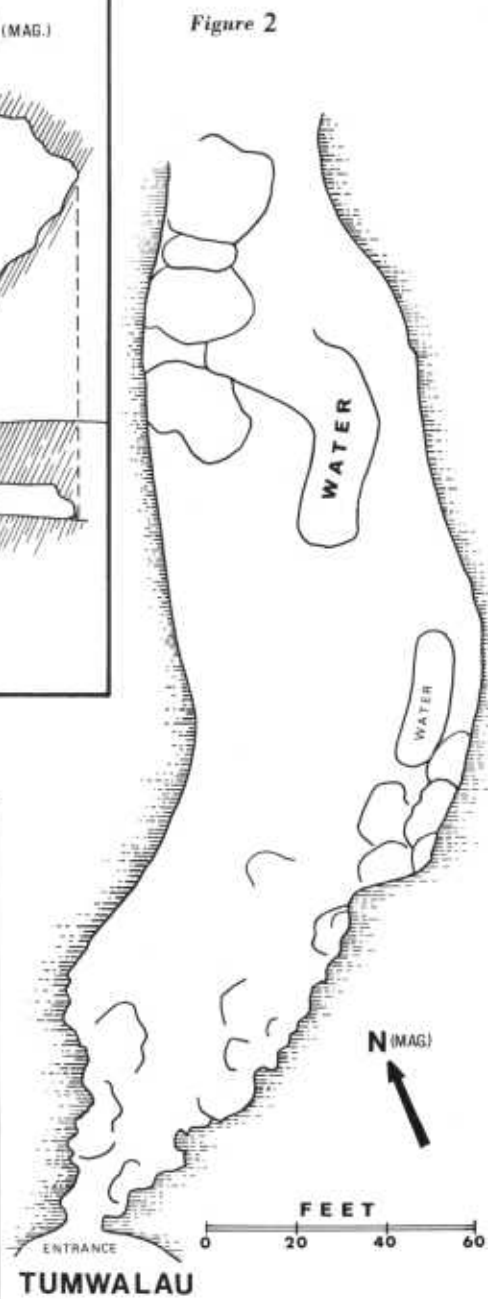
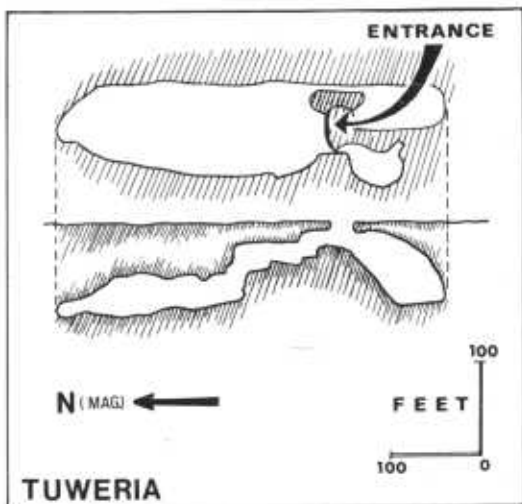
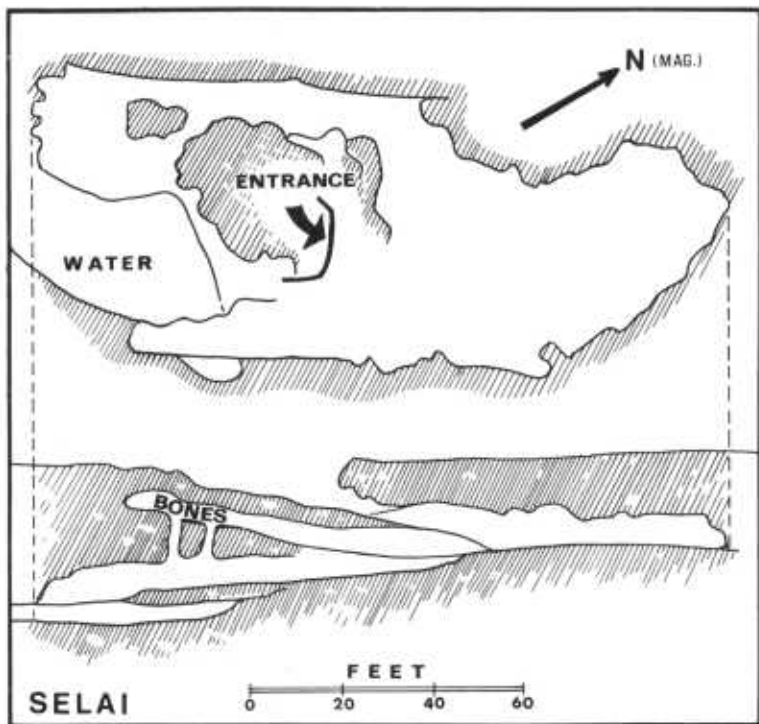
An elliptical collapse hole leads down to the three chambers that make up this cave. The main part is about 300 feet by 100 feet, but was not accurately surveyed because we could not safely descend the steep wall shown on the section. There are many bats in the cave and deep, slippery guano makes the going treacherous. As in other caves there was quite a lot of flowstone, but evidence of large-scale collapse was particularly evident here.

Tumwalau Cave (Kumwalau)

(Nearest village, Moligilagi. This cave is a few hundred yards south of Tuweria. See Plate 1 and Figures 1 and 2).

This cave is several hundred feet long to our knowledge, and is said to extend almost to the sea. We explored until the water became too deep. Further exploration would require a boat, lilo, or such other device, and waterproof lights. The entrance is large and high, with many stalactites on the roof. The floor consists of fallen blocks with some flowstone. The cave contains bats, and we saw a small, dark fish. A small white fish and a bright red shrimp are said to be found in the cave.

The cave is reached by a road that is almost driveable, and outside the entrance is a large, concrete pad, the base of a pumping station used during the Allied wartime occupation.



Kuvwau Cave

(Nearest village, Okaiboma. See Plates 2 and 3; Figures 1 and 3).

The cave is reached by walking about half a mile south of Okaiboma along the beach and then cutting inland, where a number of shelves and shallow caves are found in the cliffs.

This small cave has an entrance almost blocked off by a grill of dripstone columns, making it almost a cage. Chockstones have been artificially placed between the columns in an effort to close up the cave. Inside the cave are a great many human bones. These are lying in disorder and no complete skeletons or even limbs can be determined. Several skulls had neat holes in the crown.

Mwagai Cave

(Nearest village, Kwabula. See Figures 1 and 3).

This is one of the most decorated caves and would be a possible tourist cave if access was not so difficult. It can be reached only after a long walk across a bush covered, coral ridge strewn with irregular and sharp-edged boulders.

The eastern half of the cave is an irregular and fairly narrow dry chamber with a certain amount of stalactite and stalagmite formation and a red earth floor instead of the guano and rock found in most Kiriwina caves. In the west is a large chamber with some splendid decoration. In the northwest corner is a pool which appears to sump within a short distance, and in the southwest is another dry passage, where a few bones were found. This cave has an opening in the roof, an irregular round hole surrounded by stalactites.

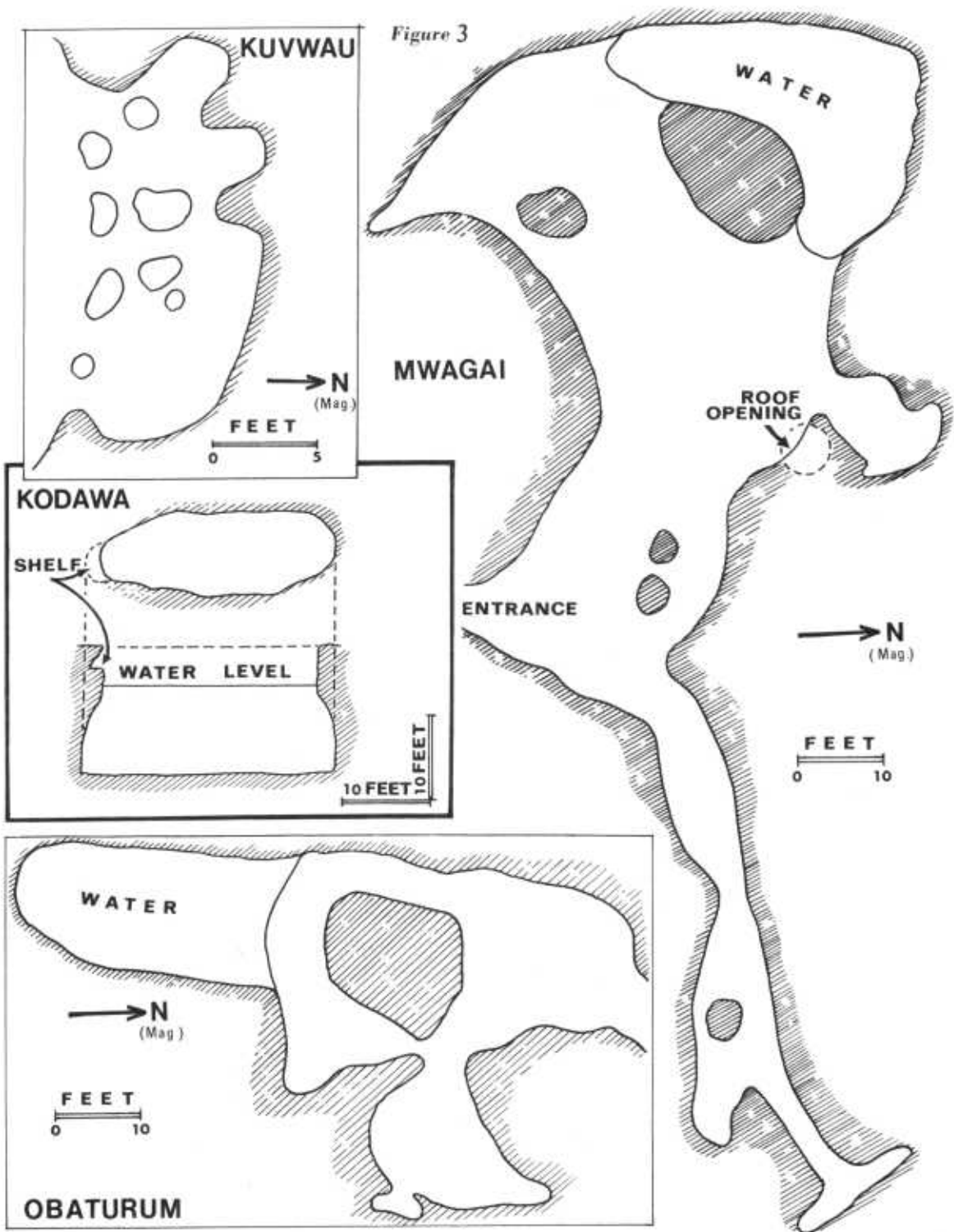
Kodawa Cave

(Nearest village, Kwabula. See Figures 1 and 3).

This feature is not a true cave but a cenote, similar to the so-called "caves" of the Mount Gambier region of South Australia. It is a roughly elliptical hole about 100 feet by 40 feet, with steep walls plunging beneath the water. The walls are often overhanging, and about 20 feet high above the water surface. The walls appear to slope outwards below the water level, and the water is estimated to be about 40 feet deep. It is fresh, extremely clear and still, and contains small black fish.

An interesting feature is the shelf at one end of the cenote. This is about 8 feet above the present water level, with a notably flat floor about 6 feet wide. It was formed presumably by some kind of undercutting when the lake was higher than at present.

Figure 3



Obaturum Cave

Nearest village, Wawela. See Figures 1 and 3).

The cave is divided into three chambers by a large mass of stalagmite. At the north is an entrance chamber, with a slippery, downward sloping floor; in the south is a low-ceilinged chamber with a lake a few feet deep that probably sumps; and in the east is a dry chamber.

This was originally a bone cave, though few bones are present now. We also found a large shell and two fragments of old pottery that might come from urns.

The Bones

Many of the Kiriwina caves contain numerous human bones, in such circumstances as to indicate that the caves, in the past, have been used as charnel-houses. Whether these were sacred or otherwise is not clear, but the balance of evidence rather suggests the former.

Limbs, pelvic bones and skulls predominate, and there seems to be a shortage of ribs, vertebrae and finger bones. The bones are occasionally associated with large shells or pots, and in some caves the bones appear to be in "bundles" with a rough parallelism among the large bones.

A number of skulls have neat, round holes in the crown, about a centimetre across, and some have two holes about five centimetres apart (Plate 3). These could possibly be wounds made by something like a club with a nail through it (or possibly two nails), possibly something like a star club. Alternatively the holes could have been made after death to remove the brains, or perhaps more simply to put the skull on a thread or impale it on a stick. Another suggestion is that the holes were made in attempts at trepanning; if this is so, the operations seem to have been uniformly unsuccessful for there are no signs of any healing. One skull has an irregular fracture on the side, probably quite enough to have killed the man. The teeth seem quite well preserved, still shiny white, and do not appear to be very old. The natives report that the bones are of "people before", and were definitely present when men now old were children. They do not appear to have any clear idea about when the bones were placed in the cave. In Selai, a few bones were slightly cemented together by dripstone.

Our native guides gave various stories about the bones. The simplest idea is that they are the remains of people killed in battle or massacre. A determination of the age and sex distribution of the bones might help to resolve this. We saw a few skulls that appeared to belong to children. Another story is that before the Europeans came the natives buried their dead in the centre of the village, but the Europeans disapproved of this for

PLATE 1

Right: Selai Cave.



Below: Tumwalau Cave.



PLATE 2



Clam shell in Kuvwau Cave is used as a container for bones.



Bones in Kuvwau Cave. Skull has fracture on the side.



Bones in Kuvwau Cave. Note skull with two round holes in crown.

reasons of hygiene, so the bodies were dug up and placed in caves. This does not account for the holes in the skulls and people are, in fact, still buried close to the villages, though now mainly just outside.

Austen (1939) reports that it was a custom of the Trobrianders to bury their dead for a time and later exhume them and transfer the bones into the caves, sometimes in pots or clam shells. In Kuvwau, we found one large clam shell (Plate 2), and another in Labai. Fragments of pottery were found in Obaturum Cave, Wawela. Funerary pots, if originally present, would very probably have been stolen by now. There are reports that this happened many years ago at Labai Cave. There are said to be caves in the south of the island that still contain pots. Exhumation and re-location of bones would account for the scarcity of small bones mentioned earlier, and for the fact that the bones appear to be in "bundles" in some caves.

The bones we saw were of normal size, but there are reports of very large bones, which may fit with other stories of a race of giants who lived on Kiriwina before the present inhabitants.

Geomorphology

Kiriwina was once a coral atoll. Uplift relative to sea level caused the atoll to emerge and form the present island; the old lagoon is now the swampy, low-lying centre of the island, and the old reef makes a ring of hills rising to over 150 feet around the edge of the island.

When coral islands are of sufficient size they hold a lens of fresh water, and solution tends to be concentrated at the surface of the watertable, where primary caves are formed. Subsequently, these may be modified by collapse and the growth of speleothems. Such appears to be the origin of the Kiriwina caves.

We had thought that coral island caves might be distinctive, even possibly retaining initial cavities from the time when the island was still a reef. In fact, we were unable to detect any such features, and the caves appear to be normal karst caves.

That the caves were initiated near the watertable seems obvious from their present position and from the fact that many caves still contain water. However, we rarely saw much indication of the original solutional form because of the great amount of subsequent alteration due to collapse, and the extensive deposition of flowstone on walls.

A fairly common feature of coral island caves generally is the development of major flow lines that eventually form tunnel-shaped caves leading towards the sea. On Kiriwina, only Tumwalau even approximates to this type of cave, and no large cave opens on to the shore. Perhaps the coral of Kiriwina is more prone to collapse than the average. The existence of a cenote

(Kodawa) is interesting. This sort of feature is typical of young karst generally, but we had not expected to find one on a coral island.

Apart from the shelf on one wall of Kodawa, none of the caves shows any evidence of a number of distinct stages in development. From the cave evidence it would seem that the island was uplifted fairly rapidly and that there has been only one main period of cave formation.

Acknowledgments

For help in locating, reaching and exploring the Kiriwina caves, we wish to thank Mr. T. Ward, Mr. T. Cosgrove and Mr. B. Egloff.

Reference

AUSTEN, L. 1939 : Megalithic Structures in the Trobriand Islands. Oceania, X (1) : 30 - 53.

BOOK REVIEW

"HOHLENKUNDE. By H. Trimmel. Vieweg, Braunschweig, 1968.
viii + 300 pages, 88 figures, 697 references, index.

This book intends to provide a serious introduction to all aspects of cave science for students and for all those to whom caves offer a change for adventure. But so much have the various facets of speleology developed of late, one may wonder whether it is still feasible for a single author to tackle the gamut at more than a popular level. If anyone can still hope to attempt it with success, the man is Dr. Hubert Trimmel, to whom we owe the "Internationale Bibliographie für Speläologie". His whole life and education have been devoted to caves and he is now officially a speleologist in three roles - as a state conservator of caves, as an examiner of "leaders" and as a lecturer on karst studies at the University of Vienna. Few men can be as widely read cave-wise as he and this may be the last treatise of cave science to come from the pen of one man. If so, it is appropriate that it should be written by an Austrian since in no country is speleology more respected than in his.

The first part, "geospeleology", deals with the geomorphology, sediments, hydrology and meteorology of caves. Expectably this is the longest single section and perhaps the most authoritative because Trimmel is primarily a physical geographer. Criticisms to be made here are that the chemistry of the H₂O-CO₂-CaCO₃ system is scarcely touched on and cave hydrology and meteorology are given proportionately very little space. Then comes "biospel-

eology", the next largest section; it includes a discussion of vertebrate fossils from caves as well as dealing with living cave organisms. The main systematic questions of biospeleology seem to be introduced in a satisfactory way but the survey of all the orders of the animal kingdom in relation to caves in eight pages becomes a not very useful list.

The most novel part of the book entitled "anthropospeleology" compasses the manifold relations of men and caves. Inevitably this rests largely on cave archaeology, including cave art, but goes beyond this to treat of a variety of other topics such as the role of caves in literature, painting and legend, the naming of caves, the use of caves for religious purposes, and the physical and physiological reactions of men to living in caves. The modern economic uses of caves are the subject of a separate section called "applied speleology" and cave conservation is touched upon briefly here.

The "historical speleology" section describes the development of cave science over the centuries, ending with lists of main caving organisations and journals. Though the Australian Speleological Federation is named among the organisations, Helictite is not listed amongst the journals; however, it is reassuring to see that in this respect it is in the goodly company of the Transactions of the Cave Research Group of Great Britain. The brevity of the "technical speleology" part will make it disappointing to the average caver. A single sentence disposes of ropes, recommending nylon or perlon without comment; this will scarcely be regarded by many as an adequate introduction to a matter of such importance.

In the final section on "regional speleology" the task of being up-to-date and of selection and compression is greatest. Some inaccuracy here is unavoidable; one notices, for example, that Dan-yr-Ogof and Ogof-Ffynnon-Ddu are mentioned as examples of coastal caves in Gower and Pembrokeshire. Nevertheless the overall impressions given are those of the amazing reach of the author's knowledge and of judicious highlighting of the most noteworthy from each country's array of caving areas and caves.

Australian speleologists will inevitably compare this book with "British Caving", a larger book and by many authors it must be remembered. What "British Caving" covers, it covers more thoroughly and more readably. However, Trimmel's book is much more comprehensive and more universal in scope. The relationships of the different aspects of cave science to one another and to the whole stand out more obviously. But it is much more potted and encyclopaedic in style, less easily read at length and more of an occasional reference work. Its substantial, even if still highly selected bibliography, will be very useful indeed. No-one can escape his own background, however; the book remains much influenced by the central European scene. There is some justice in this because so many of the world's caves are found in Mesozoic limestones of high mountain ranges due to Tertiary-Quaternary earth movements. Nevertheless Anglo-American readers will no doubt be surprised to find no reference to origins by vadose versus phreatic action, nor to

watertables. Australian readers will find the cave climate account highly blinkered in the direction of cool, humid caves and no reference at all to the literature (admittedly modest) on the conditions in hot, relatively dry caves. Despite such limitations, Hubert Trimmel has given us a notable addition to speleological literature. - J. N. Jennings.

ABSTRACTS AND REVIEWS

TWO SMALL-SCALE SOLUTION FEATURES OF LIMESTONE OUTCROPS IN SARAWAK, MALAYSIA. By J.R.D. Wall and G.E. Wilford. Zeitschrift für Geomorphologie, 10, 1966 : 90 - 94.

First description of ripple-like patterns and hemispherical channels on Upper Jurassic limestone outcrops near Kuching, Sarawak, Malaysia. The outcrops rise to 500 metres above local basal level. The ripples are asymmetrical in vertical section with sharp crests and occur on outcrops with steep to overhanging faces. The surfaces are usually beneath places where water seepage channels drain pockets of organic soil and mosses. Scallop-like forms are common on the more irregular rock surfaces. Well-developed ripple patterns are mainly restricted to the smoother surfaces. The authors assume that gravity, surface tension and friction of the water flowing down the rock face all play a part in producing the pattern.

"Root grooves", irregular series of small hemispherical grooves, traverse joint faces in three areas. In places, roots actually occupy and almost completely fill the grooves. The authors envisage formation being caused by entry of a fine hair root into a tight joint containing a thin film of soil. Acid exudated from the root dissolves a tube along the root path as it grows (and even after the death of the plant). Later, the moist surface of the root helps to enlarge the groove. This also encourages penetration by larger roots which may prise the joint blocks apart. - E.A.L.

THE NEED FOR PRESERVATION OF ABORIGINAL CAVE ART. By R. Edwards. Roy. Geog. Soc. of A'asia., South Aust. Branch, 67, 1966 : 9 - 19, + 4 plates.

This paper opens with a brief discussion of primitive art, particularly that of the Australian aboriginal. Past attempts to protect rock paintings from natural weathering and vandalism are mentioned, including the protection afforded over the centuries by aboriginal tribal law and ceremonies. The author stresses that as the aborigines are losing interest in cave art or are dying out, their paintings are beginning to fade and unless a site is naturally well protected, deterioration will progress slowly, but surely. Much of the cave art of the Australian aborigine, like that of other primitive peoples, is threatened with complete destruction. A venture by the

Australian Institute of Aboriginal Studies and the South Australian Museum to make a complete photographic record in monochrome and colour of Australian aboriginal art sites is outlined. Several areas in northern and central Australia are discussed with cave painting sites ranging from rock shelters and fissures to sizeable "caverns". Photographic progress to the end of 1966 is reported. Resultant basic photographic procedures are promised for inclusion in a proposed field manual for archaeologists working under Australian conditions. Although no true caves in the speleological sense are referred to, the paper has much of real value for speleologists. - E.A.L.

ABORIGINAL CAVE PAINTINGS, MOUNTAIN CREEK WATERHOLE, ST. VIDGEON, NORTHERN TERRITORY OF AUSTRALIA. By C.P. Mountford and E. Brandl. Rec. S. Aust. Mus., 15 (3), 1967 : 371 - 382.

This paper describes a group of cave paintings at Mountain Creek Waterhole, adjacent to the St. Vidgeon Station, near the lower reaches of the Roper River, Northern Territory. The paintings are illustrated and include human figures, various animals, bird tracks, negative hand-prints, etc. The term "cave" is rather loosely used in the literature referring to Australian aboriginal paintings. In this instance the paintings were found on the walls and ceiling of a tunnel in a line of sandstone cliffs. The tunnel is more than 600 feet long, 7 to 12 feet high and averages about 25 feet wide. It is lit, somewhat dimly in places, by a number of small openings in the walls and ceilings, and by a cave (about the centre of the tunnel) which has cut right through the tunnel to the back wall. Most of the paintings are concentrated on the walls and ceilings of the cave and tunnel. The paintings are the first examples of cave art to be recorded from this part of Australia. The authors suggest that future research may show that the site is one of the meeting places of certain motifs which have been diffused from the Pacific areas to northern Australia, e.g., "Heraldic Women", "squatting" figures, and "joint marks", and concentric circles - a dominant motif in the art of central Australia. The "joint marks" are swellings on the limbs and joints of human figures. The tunnel in which the paintings occur is also a burial cave, the floor being littered with human bones. - E.A.L.

UNDERGROUND WATER MOVEMENTS IN THE LOBSTER RIVULET - MOLE CREEK DIVIDE, TASMANIA. By J.N. Jennings and B.N. James. Aust. J. Sci., 30 (3), 1967 : 108 - 109.

In 1959, Jennings and Sweeting (Aust. J. Sci., 21 : 261) postulated that the divide in Ordovician Gordon Limestone between the Lobster Rivulet and Mole Creek valleys in northern Tasmania is breached by an underground connection of one mile between Honeycomb Caves on the eastern side and Mole Creek Rising on its western side. Water-tracing tests by the Southern Caving

Society (Hobart) in 1966 have proved a more complex pattern of water movements in the area than previously envisaged. Not only has proof been obtained that the Lobster Rivulet catchment does feed some of its water into the Mole Creek catchment, but a stream well west of the divide crosses underground to its eastern side to mingle with eastern water and emerge at the surface prior to returning underground to the valley which, from surface topography, might be expected to receive its discharge directly. Although interpretation of these movements requires greater stress on structure than given previously, the new evidence is regarded as providing further support for the process envisaged by Jennings and Sweeting in 1959 to help explain drainage movements here. This is the decanting of glacial meltwater from glacifluvial fans occupying the valley floors into the divide between them and the consequential opening up of the limestone there more fully for underground drainage. - E.A.L.

ORDOVICIAN CONODONTS FROM NEW ZEALAND. By A.J. Wright. Nature, 218 (5142), 1968 : 664 - 665.

Ordovician conodonts have been recovered from limestone samples from three areas in the northwest of Nelson Province, South Island, New Zealand. The localities are Thompson Creek, Mount Patriarch and the Takaka River valley. The areas lie near the western, southern and eastern extremities of outcrops of Ordovician limestones. Previously all limestone in this area was termed "Mount Arthur Marble" and was considered to be Upper Ordovician. The fauna from the Thompson Creek limestone appears to be significantly older than that from Hailes Knob limestone (Takaka River valley). The Mount Patriarch fauna may be the oldest of the three faunas. This preliminary survey suggests Ordovician limestones of diverse age in northwest Nelson, rather than simply of Upper Ordovician age. Several areas of speleological interest occur in this limestone. One cave system has a depth of over 1,400 feet, including a vertical shaft of about 700 feet. - E.A.L.

THE GEOLOGY OF SARAWAK AND SABAH CAVES. By G.E. Wilford. Geological Survey, Borneo Region, Malaysia, Bull. 6, 1964 : 181 pp, including 111 text figures, plus 85 plates.

This paper is a record of geological information on Sarawak and Sabah caves collected by Dr. Wilford since he joined the Geological Survey in 1949, until 1962. The main cave regions and caves are described briefly and the probable history of cave formation outlined. The origin of the limestone caves appears to be related to past fluctuations in the watertable and consequently the Sarawak and Sabah caves provide valuable evidence of sea level changes. A considerable number of cave entrances have been used in the past as human dwellings or as burial grounds and many await archaeological investigation.

The maps of Sarawak caves have been drawn mostly from compass-pace and compass-tape traverses. Most of the North Borneo cave maps are reproduced from the work of P. Orolfo, a Forest Ranger of the North Borneo Forest Department, and made in 1930-1. Heights of most cave passages are estimates.

The limestones are of Permian, Jurassic and Cretaceous age in West Sarawak and mainly of Tertiary age in East Sarawak and Sabah. The 20 largest outcrops which contain caves cover an area of about 200 square miles. Tropical erosion of the limestone has resulted in isolated, cliff-bounded, rugged hills and mountains, in places partly surrounded by swampy areas underlain by limestone from which small limestone pinnacles project. Cave systems penetrate far into many of the limestone hills and most entrances occur in the cliffs which surround the hills. Nearly all the cave passages follow bedding planes and joints. Most contain solution features which indicate that they were formed by slowly moving groundwater at a shallow depth below the watertable. A few of the passages have been modified by swiftly moving water and were, or are, occupied by surface streams.

Large, spectacular caves are most likely to be discovered in the uninhabited and relatively unexplored Melinau area in north Sarawak. Here the Api and Benarat mountains could contain cave systems several miles long. The limestone has a maximum thickness of 6,000 feet and forms rugged mountains with peaks 5,000 feet high bounded by cliffs up to 2,000 feet high. There are probably hundreds of caves in the area, but few have been visited. The most spectacular roof heights are found in caves at Gomantong, Sabah, where joint passages are up to 475 feet high.

Niah Great Cave in the Gunong Subis limestone massif 40 miles southwest of Miri is the best-known and probably the largest and one of the most outstanding caves in Borneo. Human remains dating back at least 50,000 years have been found by Sarawak Museum staff in recent years.

The author devotes 30 pages to a general discussion on limestone caves in Sarawak and Sabah giving details of limestone distribution, composition and structure, topography, general features such as typical cross sections of cave passages, minor features such as roof cavities, vertical grooves in walls, scallops, etc., cave deposits such as clay, sand and gravel, bat and bird guano and associated phosphate deposits (which occur in most of the larger caves), calcite and gypsum occurrence. Several caves in Sarawak have been mined also for gold. Caves in non-calcareous rock are discussed briefly - these consist of small marine caves, sandstone caves, and one lava cave about 450 feet long discovered in 1960 in southeastern Sabah. This is the first lava cave found in Borneo. A brief chapter discusses the origin of caves and cave deposits. The following 127 pages is devoted to maps and brief descriptions of limestone regions and references to hundreds of caves with descriptions and maps of the more important. A most valuable speleological publication. - E.A.L.

THE USE OF ETHYL MERCAPTAN IN CAVES. By B.G. Muir. Western Caver, 8 (3), 1968 : 60 - 61.

It was suggested in Bull. Nat. Speleo. Soc. U.S.A., 22, 1960, that ethyl mercaptan be used in caves for detecting air currents and inter-connection of cave systems as its fumes will penetrate into all regions of a cave in which it is deposited. Muir considers the use of this chemical is dangerous because of its effect on the cave fauna, and has proved his contention by a series of laboratory experiments on Western Australian cave arthropods. Insects used were Shawella douglasi (cockroach), Protochelifer (pseudoscorpion) and Ptinus exulans (beetle from guano). Surface insects also tried in the experiments included long-horned grasshoppers, silverfish and springtails. Two cages with these insects were placed in a dark room at 20°C. Ethyl mercaptan was placed on cotton wool in one cage, and acetone, a fuming, highly volatile, but relatively non-poisonous chemical, also on cotton wool in the other cage. After one hour all insects in the cage with ethyl mercaptan were dead, whereas all insects in the cage with acetone survived. Because of these results, it is considered that the use of ethyl mercaptan for tracing should be condemned. Muir considers ethyl mercaptan could also be dangerous to speleologists, although its full effects are not completely known. - A.M.R.

THE BIOLOGY, ORIGIN, AND ADAPTATION OF MINIOPTERUS AUSTRALIS (CHIROPTERA) IN NEW SOUTH WALES. By P.D. Dwyer. Aust. J. Zool., 16, 1968 : 49 - 68.

The biology of Miniopterus australis was investigated in northeastern New South Wales (latitude c. 30°S) between 1960 and 1966. In this area the species reaches the southern limit of its distribution and is largely confined to the subtropical coastal belt. Mating occurs in the winter months June and July, and is followed by a period of retarded embryonic development to mid-September. Births occur in December. The only nursery colony of M. australis located was that of the southernmost population of the species. It included about 4,000 individuals (approximately 1,800 young) in December and was intimately associated with a much larger nursery colony of M. schreibersii. A comparison of the winter behaviour of M. australis with that of M. schreibersii at the same latitude revealed that pre-winter increase in weight is less marked, that feeding behaviour persists longer, and that there are fewer, and less rigid, periods of torpidity in the former species. In its reproductive and wintering characteristics M. australis, at 30°S, has diverged less from the tropical, and presumably ancestral, pattern for the genus than has M. schreibersii at the same latitude. It is argued that M. australis has colonised New South Wales from low latitudes later than M. schreibersii and that colonisation southwards may have been dependent upon, or promoted by, the prior existence of M. schreibersii nursery colonies.

An analysis of retrapping data for the southernmost population of M. australis suggests that this is represented as two subpopulations (highland and lowland) between which adult individuals seldom exchange. Spermatogenesis, and hence mating, occurs slightly earlier in the highland subpopulation. It is suggested that earlier mating in this subpopulation may be selectively advantageous, and that the long-term effect of selection here could be to shift the timing of reproduction events in the entire population back towards that observed in M. schreibersii. Earlier mating should be correlated with a stronger manifestation of pre-winter increase in weight and of winter torpidity. The combination of all these changes in M. australis would permit further range expansion to the south and west, provided that suitable nursery sites are available and can be found.

ACROSS NEW GUINEA FROM THE FLY TO THE SEPIK. By I.F. Champion. Lansdowne Press, Melbourne, 1966. 225 pp + 22 plates, and foldout map. First published by Constable, London, 1931.

This book, recently re-published in Australia in a new edition, has general interest for speleologists because of many references to New Guinea limestone areas which show the great difficulties confronting cave expeditions visiting the highlands.

The volume is a description of the first expedition, in 1927-28, to cross the island of New Guinea at its widest point by way of the headwaters of the Fly and Sepik Rivers, and of an earlier unsuccessful expedition in 1926-27. Both expeditions were led by C.H. Karius. The author was the only other European on the expeditions. The book contains some dramatic descriptions of the formidable limestone barrier ranges in the vicinity of the Blücher, Kaban, Dap and Victor Emanuel Ranges and the difficulty of moving through them. Karst areas clothed with moss-covered rain forest were encountered at about 7,000 to 9,000 feet altitude, limestone rocks with razor-like edges to climb over, clefts up to 20 feet wide to cross by rotten tree trunks or the roots of trees where a fall meant empalement on needle-pointed pinnacles of limestone, successions of pot-holes 30 to 100 feet deep to climb in and out of, and frequently the sound of water running underground. The limestone pinnacles down many of the clefts only served to break the hole into smaller ones which went "into the bowels of the earth." It was necessary in these areas to prod with a stick every patch of moss on the ground and every piece of fallen timber before stepping on to it to ensure a firm foothold and not just a thin cover over a hole in the limestone. - E.A.L.

THE GEOGRAPHICAL DISTRIBUTION OF AUSTRALIAN CAVE-DWELLING CHIROPTERA. By E. Hamilton-Smith. Int. J. Speleol., 2, 1966 : 91 - 104.

Of 56 species of bats currently recorded from Australia, 22 occur in caves. The geographical distribution of these species is given, and they are divided into four groups. Group I comprises species occurring north of 18°S. These either also occur in New Guinea or are closely related to New Guinea species. Group II occur north of 28°S in a desert or semi-desert terrain. Group III occurs in the Eastern Coastal Region. Group IV are widespread, belong to the Vespertilionidae and occur in caves only occasionally. Possible factors contributing to the origin of these distribution patterns are discussed. - A.M.R.

NOTES ON THE BIOLOGY OF TWO SPECIES OF RHAPHIDOPHORIDAE (ORTHOPTERA) IN TASMANIA. By Aola M. Richards. Proc. Linn. Soc. N.S.W., 92 (3), 1968 : 273 - 278.

A series of observations have been made on the biology of Micropathus cavernicola Richards and M. tasmaniensis Richards in three widely separated parts of Tasmania. The caves examined are Marakooa Cave and Little Trimmer Cave at Mole Creek, Cashion Creek Cave in the Florentine Valley, and Mystery Creek Cave at Ida Bay. Environmental conditions are given for the four caves. Temperatures are among the lowest recorded from Australian caves containing cave crickets. In all caves relative humidity is very high. Food preferences of the cave crickets are discussed, and it is shown that they are omnivorous scavengers. In both species seven pre-adult instars are passed through. In November, 1966, all instars were present in the populations. This is unusual, but can probably be explained by variations in the length of the developmental period and the presence of two generations in the population. It is probable that all instars are present only during spring and early summer when hatching is occurring and overwintering nymphs are maturing into adults. - A.M.R.

FAUNA OF THE DARK CAVE, BATU CAVES, KUALA LUMPUR, MALAYSIA. By H.E. McClure, Boo-Liat Lim and Sarah E. Winn. Pacific Insects, 9 (3), 1967 : 400 - 428.

Observations and collections of the fauna of the Dark Cave of Batu Caves at Kuala Lumpur, Malaysia, were made between May, 1959, and January, 1961. The caverns have an extensive invertebrate population, many species of which remain unidentified. Twenty-three species of vertebrates were observed, the most abundant being the two bats Eonycteris spelaea and Hipposideros diadema. The collections included 151 identified species of 94 families of invertebrates. Coprophagous mites of several species and Diptera were the most abundant arthropods. Populations and species make-up varied from the entrance to the rear of the caverns. Most species developed maximum populations where light and moisture conditions were optimum. - A.M.R.