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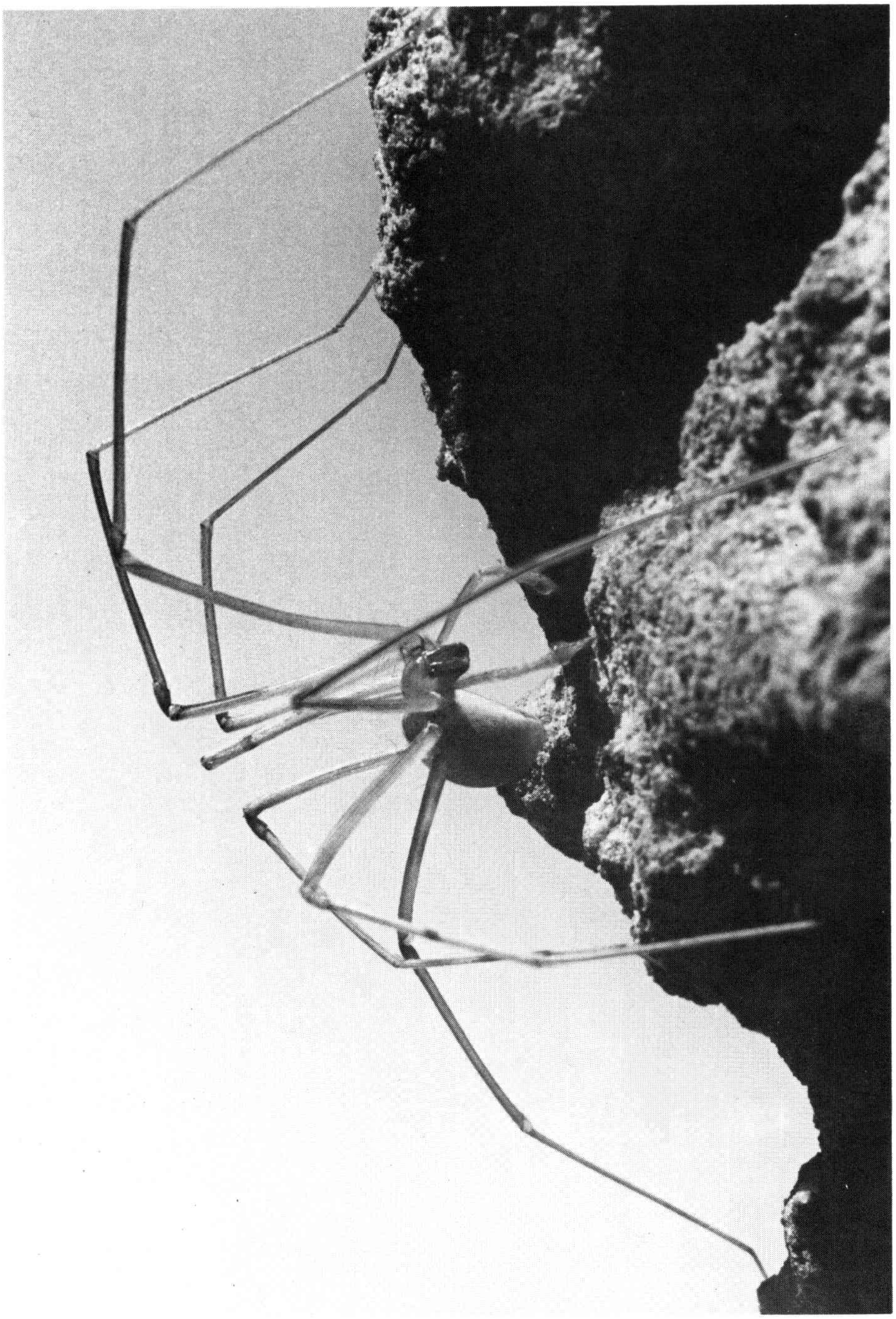

Tartarus mullamullangensis, a blind spider from Mullamullang Cave, Nullabor Plain.

(Photo, B. MUIR)

"H E L I C T I T E"

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Editors

E.A. Lane, Aola M. Richards, J.N. Jennings

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CONTENTS

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ABSTRACTS AND REVIEWS

LAND RESOURCES OF THE VANIMO AREA, PAPUA NEW GUINEA. Edit. by E. Löffler, with papers by other authors. Land Research Series No. 31, CSIRO Div. Land Research, Canberra, ACT, 1972 : pp 126, 20 plates, including 16 air photograph stereopairs, 2 foldout maps in pocket.

This publication is a collection of papers discussing different aspects of land systems in the Vanimo area (including geomorphology, soils and vegetation). Of the 39 land systems, seven are described as having karst features or subterranean drainage (Madang, Ijapo, Jassi, Oenake, Musu, Kohari and Serra). Karst features in the last two systems (dolines, cone karst, etc.) are prominent on the air photographs (Plates 14, 18 and 19). - G.S. Hunt.

QUEENSLAND'S GRANITE BELT IN COLOUR. By Errol Walker. 1972. Pub. by Walklee Publications, Stanthorpe, Q'ld. Pp 57 + end pages.

General district publication, mainly photographs with captions of varying length. Contains brief notes on Texas Caves near the Queensland-NSW border, plus five excellent colour photographs. Location of caves is shown on district location map at end of book. - E.A.L.

LES ISOPODES TERRESTRES DE L'AUSTRALIE ETUDE SYSTEMATIQUE ET BIOGEOGRAPHIQUE. By A. Vandel. Mem. Mus. natn. Hist. nat., Ser. A, 82 : 1 - 171, 1973.

Three troglobites are described: *Styloniscus australiensis cavernicolus* n. sp. (Sausage Cave, a lava cave at Mt Hamilton, Vic.; Labyrinth and Calgadup Caves, Augusta area, WA), *Abelaioscia troglodytes* n. sp. (Pannikin Cave, Nullarbor Plain, WA) and *Hybodillo australiensis* from Giants Cave (Augusta area, WA). The eyes are reduced in *H. australiensis* and completely absent in the other two species. *A. troglodytes* has extremely long antennae and all species show some degree of depigmentation.

Three troglophiles are also described: *Laevophiloscia dongarrensis* Wahrberg, *L. hamiltoni* n. sp. and *Euygaster montanus troglodytes* n. sp. (although this last species was collected from just outside the cave). There are also many other records of slaters being taken in caves. Two Australian troglobitic isopods described by earlier authors are referred to and both exhibit depigmentation and eye regression: *Philoscia subterranea* Budde-Lund and *Armadillo cavernae* Wahrberg.- G.S. Hunt.

SURVEY OF THE SPIDER FAUNA OF AUSTRALIAN CAVES

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Abstract

A preliminary list of spiders from Australian caves is given and discussed. Some 90 species in 23 families are represented. While the fauna is essentially troglophilic, 11 species are classed as troglobites and a further 12 species as advanced troglophiles. The cave adapted fauna is largely confined to southern Australia with the notable exception of the pholcid troglobite, *Spermophora* sp. nov., which is a tropical relict. Troglobitic representatives of the families Pholcidae and Theridiidae are recorded for the first time. A maximum age of 2.5-3.0 million years is suggested for the troglobitic fauna. A comparison of the Australian and Japanese cave spider faunas is made.

INTRODUCTION

In most cave faunas, spiders (Araneae) are the dominant invertebrate predators and so occupy a significant niche in cave ecosystems. Previous discussions of the fauna of Australian caves have had little to say about cave spiders beyond the suggestion that they appear to be fairly common. For example, Hamilton-Smith (1967) lists only five species from Australia while Goede (1967) mentions one species from Tasmania. Regionally, the most comprehensive review has been given for the Nullarbor Caves, southern Australia, by Richards (1971). This situation is a reflection of the problems presented by spider classification rather than a lack of collecting awareness. In fact, much material has long been available but has not been subject to specialist scrutiny.

The 90-odd species listed below (Appendix I) come from cave systems throughout Australia, though a bias toward New South Wales is evident. Where possible, both cave names and numbers (after Matthews, 1968) have been included in the locality data. Doline collections have not been included in this survey.

Much of the material is still undescribed though descriptive papers are in preparation. Nevertheless, this initial survey gives a useful indication of the diversity of Australian cave spiders and the relative richness in cave-adapted species. More material is needed so that distribution patterns can be clarified.

Classification

Cave spiders include representatives of four major groups:

Liphistiomorpha. Primitive segmented spiders not represented in Australia (Japan and Malaysia each have a troglophilic species).

Mygalomorpha. Four-lunged spiders with parallel (dagger-like) fangs exemplified by the common surface dwelling trapdoor spiders and funnel web spiders.

Hypochilomorpha. Four-lunged spiders with diaxial (pincer-like) fangs closely allied to primitive araneomorph stock. The group is relatively rare and has a highly fragmented distribution.

Araneomorpha. Two-lunged or spiraculate (lungs reduced to spiracles) spiders with diaxial fangs. Examples are wolf spiders, red back spiders and orb web building spiders. Classification at family and genus level in this group is currently undergoing considerable modification (Forster and Wilton, 1973) and future nomenclatural changes can be expected.

THE SPIDER FAUNA

Mygalomorph cavernicoles

The Mygalomorpha are generally poorly represented in caves. In Australia only two species are known which can be called cavernicolous. One is a unique troglobite *Troglodiplura lowryi* (Dipluridae) which was described from cuticular fragments taken with cockroach remains in Roaches Rest Cave (N58), Nullarbor Plain (Main, 1969). Whether it is still extant is unknown. This spider is important in being the only non-tropical mygalomorph troglobite known (Vandel, 1965).

The second species is a troglophilic trapdoor spider, *Dyarcyops* sp. (Ctenizidae). These spiders are common in the soil floor of Yessabah Bat Cave (KS5), N.S.W., where they construct open V-shaped burrows.

Hypochilomorph cavernicoles

Both of the two families represented in Australia, the Gradungulidae and the Hickmaniidae, contain cavernicoles. Their surface representatives are moisture dependent forest dwellers endemic to eastern Australia and New Zealand.

Gradungula sp. is a partially dipigmented troglophile known from Cliefden, Jenolan and Yarrangobilly, N.S.W. Like the great majority of this family it is an ecribellate hunting spider characterised by much enlarged outer claws on the front pairs of legs, presumably an aid in seizing prey. This characteristic is also shown by the only web building gradun-

Figure 1 - Distributions of some cavernicolous groups of spiders.

gulid (gen. nov.) yet recorded, a partially depigmented troglophile from Carrai Bat Cave, N.S.W. (dark zone). The web of this spider is highly specialised, consisting of a tangled modified sheet above from which two silk lines lead down to a vertical "catching platform" just above ground level (Plate 1). The spider sits head down on the platform lying in wait for any ground dwelling invertebrates which may walk into or near the two ground attachments of the platform. The real importance of this spider lies in its possession of a cribellate silk spinning organ in a family otherwise consisting entirely of ecribellate species. This has important bearing on current ideas of spider phylogeny.

The large Tasmanian cave spider, Hickmania troglodytes, is a restricted relict species and the sole representative of the family Hickmaniidae. Goede (1967) states that it commonly occurs in the twilight zones of caves throughout Tasmania (and in sheltered surface habitats) where it builds an extensive sheet web (Hickman, 1928).

Araneomorph cavernicoles

The araneomorphs are by far the most diverse and numerous group in caves where at least 19 families are represented. However, although the families Ctenidae, Clubionidae, Pisauridae, Zodariidae and Uloboridae are occasionally recorded from caves (see Appendix I), they are not discussed below as they are represented by unmodified surface species.

Pholcidae. A cosmopolitan family (cellar or daddy long legs spiders) of cryptozoic web builders commonly represented by unmodified troglophiles in caves (Figure 1). The Pholcinae (seven species) are particularly common. The lava caves of the Mt. Surprise area (North Queensland) contain the only Australian troglobitic species (Spermophora sp. nov. B.). The eyes of this spider are degenerate and pigment is lacking. A related troglophile (Spermophora sp. nov. A), depigmented but with normal eye development, occurs further west at Camooweal (Figure 1).

The genus Physocyclus (four species) is also well represented in caves. One species is particularly common in Nullarbor cave entrances and dolines, but all probably occur also on the surface. The remaining five species (Appendix I) are all common surface forms inhabiting cave entrance regions.

Amaurobiidae. This is an extremely diverse group containing several distinct assemblages.

Subfamily Desinae - a behaviourally diverse group which is strongly represented in the Australian region. However, most cave representatives are allied to the Ixeuticus group (exemplified by the common black house spider I. robustus which occurs in some Nullarbor cave dolines). These spiders are generally unmodified surface forms (e.g. Forsterina spp.) but Ixeuticus socialis is of interest because it is known only from cave en-

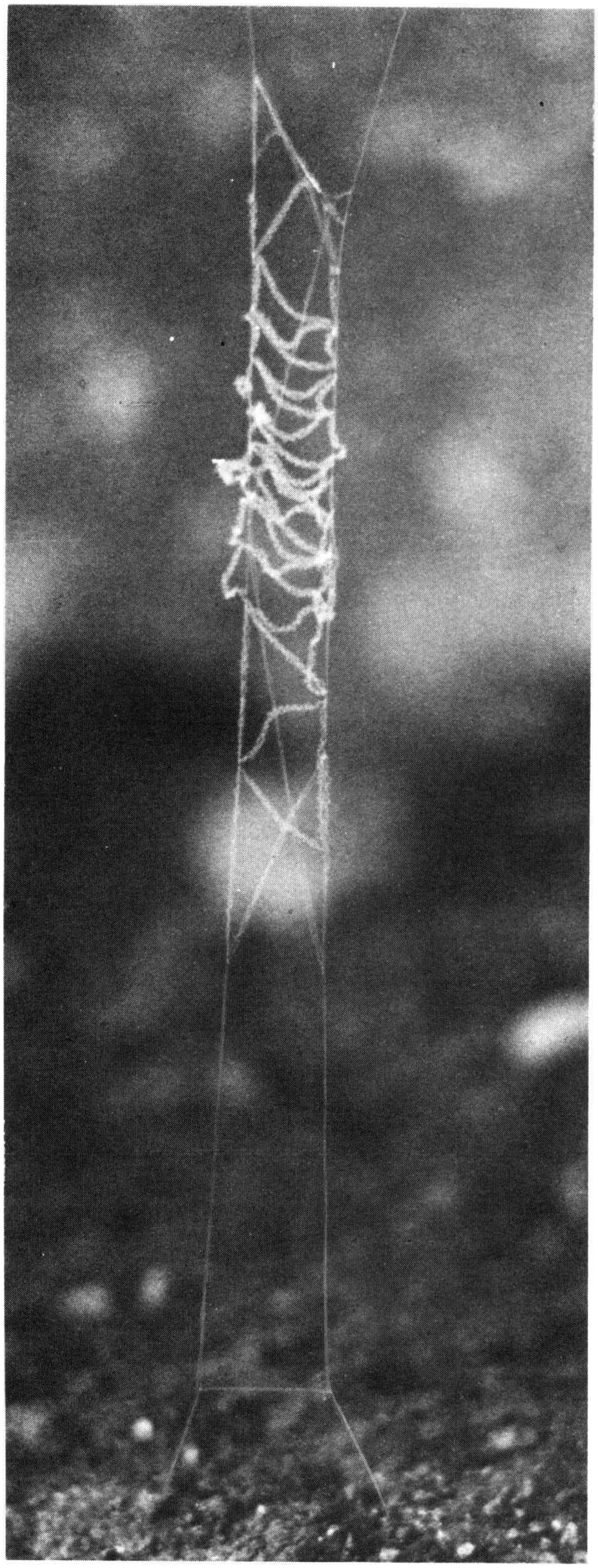

Plate 1

The "catching platform" in the lower part of the web of the cribellate gradungulid, Carrai Bat Cave, N.S.W.

(Photo. M. Gray)

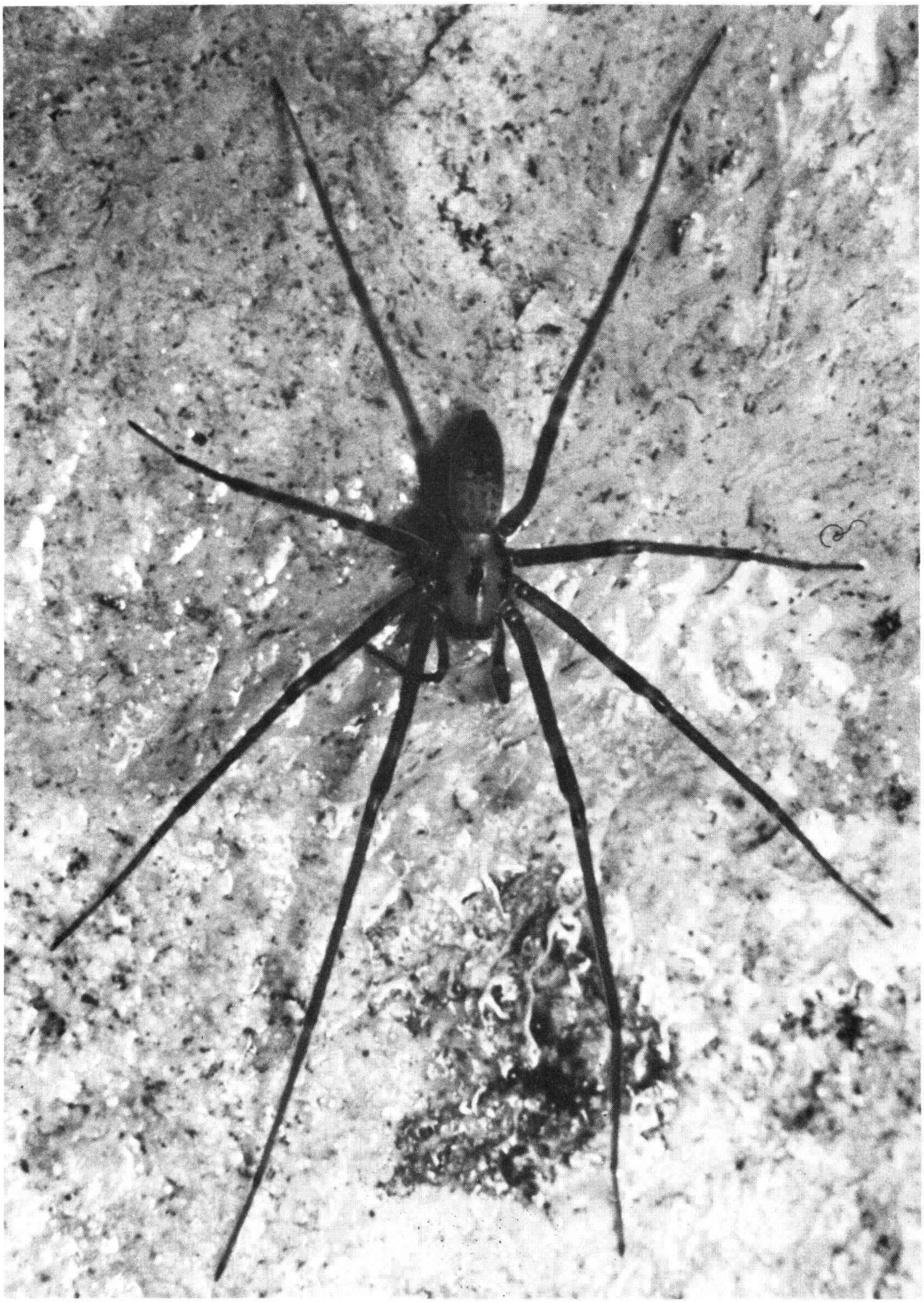

Plate 2 - A troglophile, *Baiami tegenarioides*, on a wall in
Golgotha Cave, W.A. (Photo. M. Gray)

trance regions at Jenolan (N.S.W.) and because of the enormous communal shawl webs it constructs in cave roof arches.

Subfamily Amphinectinae - a large group in Australian forest and woodland habitats. The most important cave representative is a large variably depigmented Tasmanian spider, provisionally assigned to the genus Amphinecta, which is known from all major Tasmanian caves systems except those on the west coast (Figure 1). Nothing is known of its habits but it is probably a vagrant hunter. It is a close relative of Rubrius milvinus Simon, a vagrant rainforest spider (Hickman, 1967). Epimecinus alkirna is an unmodified troglophile found in Nullarbor cave entrance regions and dolines where it constructs a horizontal shawl-like web under rocks. It has not been recorded outside doline or entrance habitats.

Subfamily Stiphidiinae - an important Australian group well represented in moist forest habitats and in caves. Stiphidion facetum is common in south-eastern mainland and Tasmanian caves. Its web consists of a squat lampshade-like funnel attached between rocks or under wall overhangs. Another cribellate sheet web builder, Procambridgea cavernicola, occurs as a depigmented troglophile in Wombeyan and Wee Jasper caves (N.S.W.).

A well defined group in this subfamily comprises the closely related genera Tartarus and Baiami (Figure 1). These spiders are all long legged, cryptozoic web builders. In southwest Australia the shawl-like sheet webs of B. tegenarioides (Plate 2) and B. volucripes are common in cave entrance chambers.

Mullamullang Cave (N37) on the Nullarbor Plain harbours a remarkable troglobitic species, T. mullamullangensis. This blind, depigmented troglobite is known only from the Dome Chamber area about six kilometres from the cave entrance (Gray, 1973). Its web is highly specialised, consisting of a wide funnel suspended between rocks (Plate 3). The feeding habits of this spider are not yet known. Potential food sources seem very limited with only the blind cockroach, Trogloblattella nullarborensis Mackerras, known to occur in the Dome Chamber. Three other potential prey species have been taken more than four kilometres inside Mullamullang: two troglophilic beetles, Brises acuticornis Pascoe and Trox amictus Haaf, and an undescribed troglobitic centipede (Richards, 1971).

Besides this spider's obvious troglobitic adaptations and specialised web, additional morphological characteristics relating to relative limb lengths and carapace shape all suggest a long history of isolation in Mullamullang Cave (Figure 2).

Agelenidae. A large group well represented in Northern Hemisphere cave and surface habitats, but much less common in the Australian region. A depigmented species from Bub's Hill on the Tasmanian west coast (Figure 1) is assigned to this family.

Miturgidae. A widely distributed group in the Southern Hemisphere with troglophilic representatives in Africa. The three related species known from caves in Australia (Figure 1) are all cave adapted to some degree, two being classed as troglobites. Janusia muiri is a blind hunting spider (Plate 4) known from two Nullarbor caves about 250 kilometres apart, Weebubbie Cave (N2) and Pannikin Plain Cave (N49) (Gray, 1973). Both specimens were taken near the respective cave entrances suggesting that these spiders may forage in the twilight zone where the food potential is much higher than in the deep cave region. A related troglobitic species from the Buchan-Murrindal area (Victoria) shows marked eye reduction and depigmentation. The third species, a depigmented troglphile is known only from caves west of Kempsey, N.S.W.

Sparassidae. Huntsman spiders are circumtropical in distribution and often occur as unmodified troglophiles in caves. Heteropoda procera is common in caves in the Comboyne-Yessabah area of N.S.W.

Cycloctenidae. An endemic family (Australia and New Zealand) of forest litter hunting spiders. Four unmodified species in the genus Cycloctenus are known from caves in N.S.W., Victoria and on Flinders Island. Interestingly, the group is not recorded from Tasmania. Toxopsiella spp. are small hunters with strongly spined legs which wander on cave walls and floors.

Lycosidae. Occurrences of this cosmopolitan family (the wolf spiders) in caves have been regarded as accidental since such highly adapted visual hunters would seem poor candidates for cave adaptation. However, Gertsch (1973) has described a blind wolf spider from Hawaiian lava caves and so previous ideas must be revised. At present, only unmodified surface species are known from Australian caves.

Mimetidae. This is a cryptozoic family of 'ambushing' spiders common in forest habitats and often present in caves as unmodified troglophiles.

Araneidae. The orb web weaving spiders are commonly represented by the subfamily Metinae in caves. Unmodified troglophiles in the genus Orsinome (a southern equivalent of the Northern Hemisphere genus Meta) are the only cavernicoles recorded at present.

Symphtognathidae. The small surface representatives of this widely distributed family construct tiny sheet or orb webs in ground litter, in moss or on bark. Two cave dwelling species are known from Australia but nothing is known of their habits. One of these, Textricella sp. nov., is a troglobite from caves at Loongana, northern Tasmania. This spider has much reduced eyes (including loss of anterior median eyes) and lacks all pigment and abdominal sclerotisation. In these characteristics, it contrasts markedly with its closest surface relative, T. fulva Hickman from southern Tasmania, which has eight well developed eyes plus pigment and abdominal sclerotisation. Another small troglophilic species is Micropholcomma longissima from Jenolan Caves (N.S.W.) which constructs tiny sheet webs in

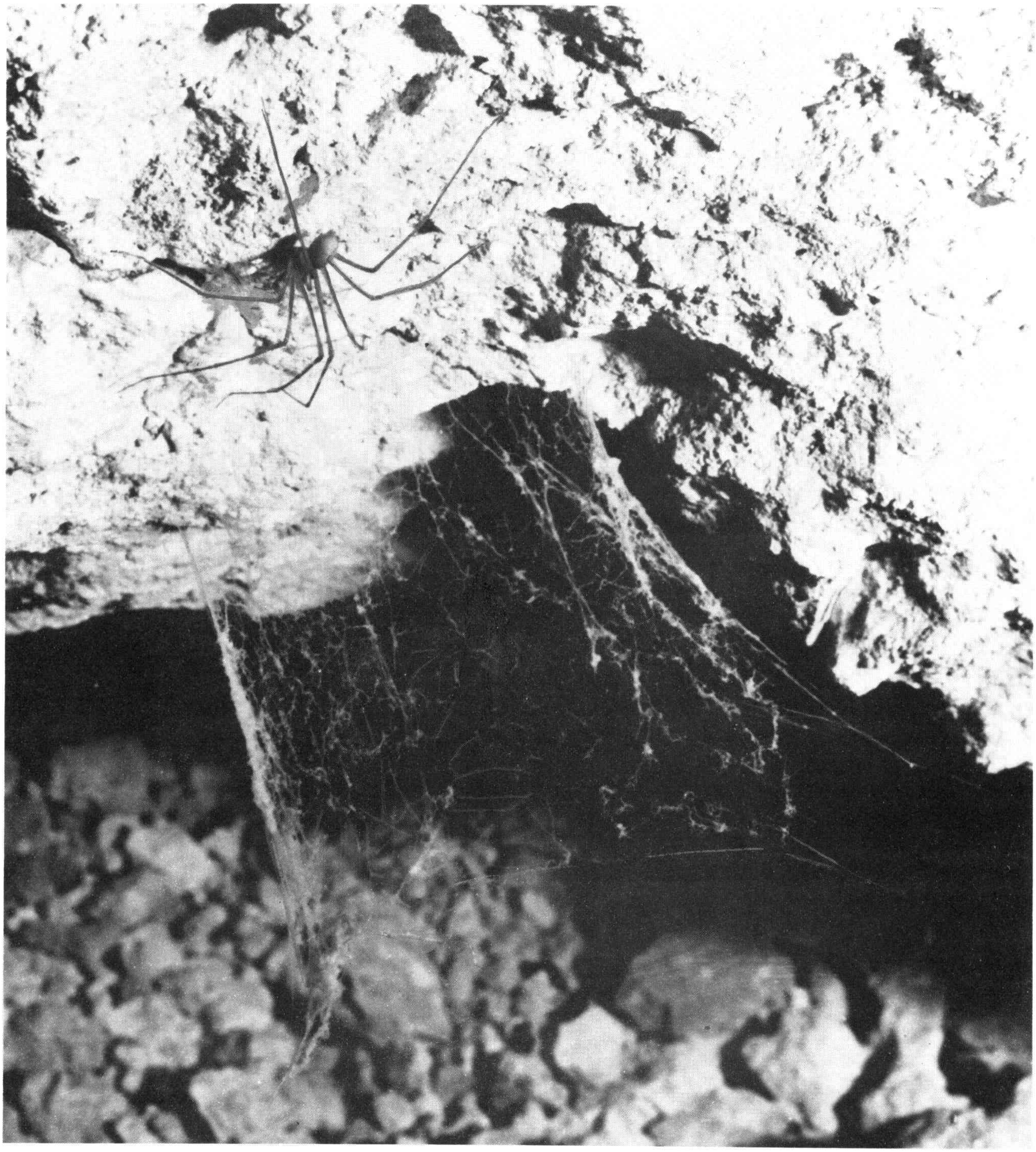

Plate 3 - A troglobite, *Tartarus mullamullangensis*, in its web in the Dome Chamber, Mullamullang Cave, W.A. (Photo. W. Crowle)

Plate 4 - A hunting troglobite, *Janusia muiri*, from Pannikin Plain Cave, W.A. (Photo. C. Turner)

crevices in active formation. It is also known from surface localities.

Theridiosomatidae. This is a small family mainly of Northern Hemisphere distribution. Its representatives are small, cryptozoic, hygrophilic, orb weaving spiders. Australian records are mainly from caves, but such specimens show few signs of cave modification. The three species so far collected are known from caves in south-east and south-west Australia (Figure 1).

Linyphiidae. This is a cosmopolitan family (the money spiders) of small hygrophilic sheet web builders which are particularly common in the Northern Hemisphere. They disperse over great distances by ballooning as evidenced by the presence of the european species, *Ostearius melanopygius* (an unmodified troglophile), in Insect Cave, Mt. Hamilton (Victoria).

Several troglophiles in the genus *Laetesia* occur across southern Australia. Only one of these species, *Laetesia weburdi* (which constructs small suspended sheet webs in folds or crevices in moist formation in Jenolan Caves), shows consistent loss of pigmentation. The Jenolan Caves also harbour our only linyphiid troglobite (gen. nov.), a tiny, white, long legged blind spider which makes a small sheet web similar to that of *L. weburdi*.

The genus *Synotaxus* contains two cave adapted species from Wyanbene (N.S.W.), and Kaoota (Tasmania) (Figure 1). The Kaoota specimen is a partially depigmented troglophile taken from a mine adit. The Wyanbene spider is probably an advanced troglophile. Its eyes are normal, though lacking pigment like the rest of the body, but the appendages, particularly the palps, are attenuated to much greater extent than is usual in this genus (Figure 3). Nothing is known of the habits of either species.

Theridiidae. Another cosmopolitan family of small web builders well represented in Australian caves. The genus *Achaearanea* is a dominant surface group in Australia and cave records are usually referable to surface species; slight depigmentation is sometimes observed (e.g. *A. extrilidum*). *Latrodectus hasselti* (red back spiders) and *Enoplognatha* spp. are both surface accidentals. The webs of all these species are common in cave entrances.

The remaining two genera contain seven cave adapted species. The most important are the six provisional species assigned for the present to the cosmopolitan genus *Steatoda*. This group of closely related species is unknown outside caves. Their small, untidy 'platform' webs above vertical trip threads are often found among cave rockpile debris. One provisional species (*Steatoda* sp. nov. A - see Appendix I) is a widely distributed, variably pigmented troglophile occurring in south-eastern caves from Kempsey (N.S.W.) to Mole Creek (Tasmania). The Mole Creek specimen is the only very darkly pigmented example known and, interestingly, it was taken among glow-worm larvae. The remaining species are all depigmented, dark zone cavernicoles showing marked but variable eye regression (Figure 2). They occur right across southern Australia with the exception of the Nullarbor Plain area (Figure 1).

Another interesting species, belonging to the cosmopolitan genus Pholcomma, occurs in Abrakurrie Cave (N3), Nullarbor Plain. This is a small, white spider lacking the abdominal pigmentation and sclerotisation often seen in its surface forest-dwelling relatives. Under present Nullarbor surface conditions it must be regarded as an obligate troglophile. A related, unmodified species occurs in Yanchep Caves (W.A.).

CHARACTERISTICS OF FAUNA

The essentially troglophilic nature of Australian cave faunas has been noted by Moore (1964) and Hamilton-Smith (1967, 1972). A similar situation is seen in the spider fauna. Of the species recorded above, about 75% are unmodified troglophiles which also occur on the surface. These troglophiles are an important, if fluctuating, component of cave faunas, particularly in the twilight zone. They are the primary invertebrate predators of this zone and their activities affect the energy regime of the whole cave. Their more cave adapted relatives, the 'advanced troglophiles' and troglobites generally occupy the deeper, energy poor, regions of the cave. These are obligate cave dwellers showing different degrees of cavernicolous adaptation (Table 1). They represent an older segment of the cave fauna than do the unmodified troglophiles and are much less variable in composition. Thus, while 22 families of spiders have unmodified cave representatives, only seven also contain troglobitic forms. These families (Pholcidae, Amaurobiidae, Miturgidae, Theridiidae, Linyphiidae, Symphytognathidae and Dipluridae) also account for a disproportionate amount of the total cave fauna, i.e. approximately 65% of all species.

Vandel (1965) notes that true cavernicoles are usually drawn from surface groups characterised by cryptozoic habits. Among the spider troglobites, obvious examples are found in the genera Textricella, Tartarus and Janusia whose surface representatives are moss, litter and crevice dwellers in forested regions. Such habitats are 'cave-like' in the relative stability of their microclimatic regimes compared to ambient conditions.

Although the Pholcidae are common in caves throughout the world, Spermophora sp. nov. B from the Mt. Surprise lava caves appears to be the first record of a troglobitic pholcid. It is also unusual in being a northern tropical relict which contrasts markedly with the southern temperate distribution and origin of other spider troglobites (Figure 4). Such lava cave troglobites should be of particular interest to cave biologists because the precision lava dating methods now available, together with the assumption that such caves would be available early for colonisation, will allow more useful estimates of the age of troglobites and their rates of evolution than are usually possible for limestone cave faunas.

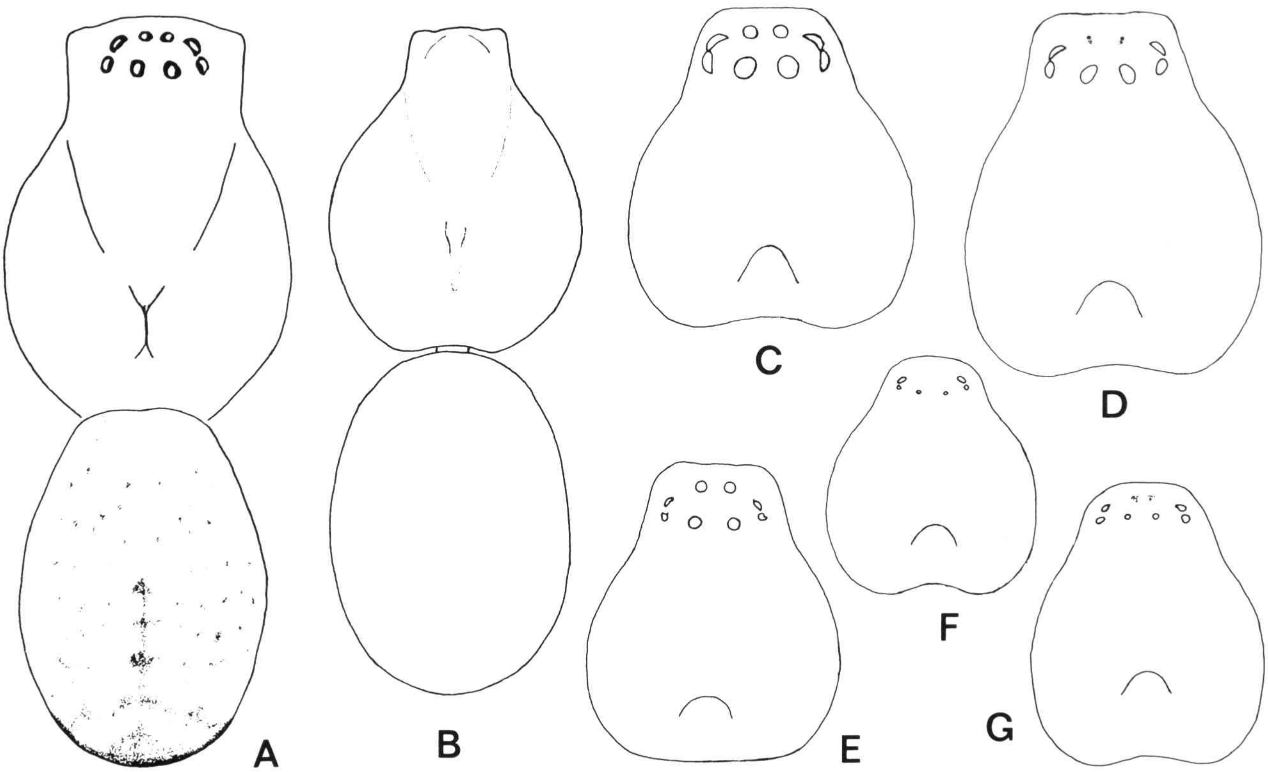

Figure 2

A,B - Dorsal view of body of two closely related cavernicoles.
A - A troglobite, *Tartarus mullamullangensis*.
B - A troglophile, *Baiami tegenerioides*.

C-G - Variation in eye regression and carapace shape in '*Steatoda* group' species.
C - Ex Buchan-Murrindal, Vic.
D - Ex Cliefden, N.S.W.
E - Ex Wichliffe, W.A.
F - Ex Nambung River, W.A.
G - Ex Yarrangobilly, N.S.W.

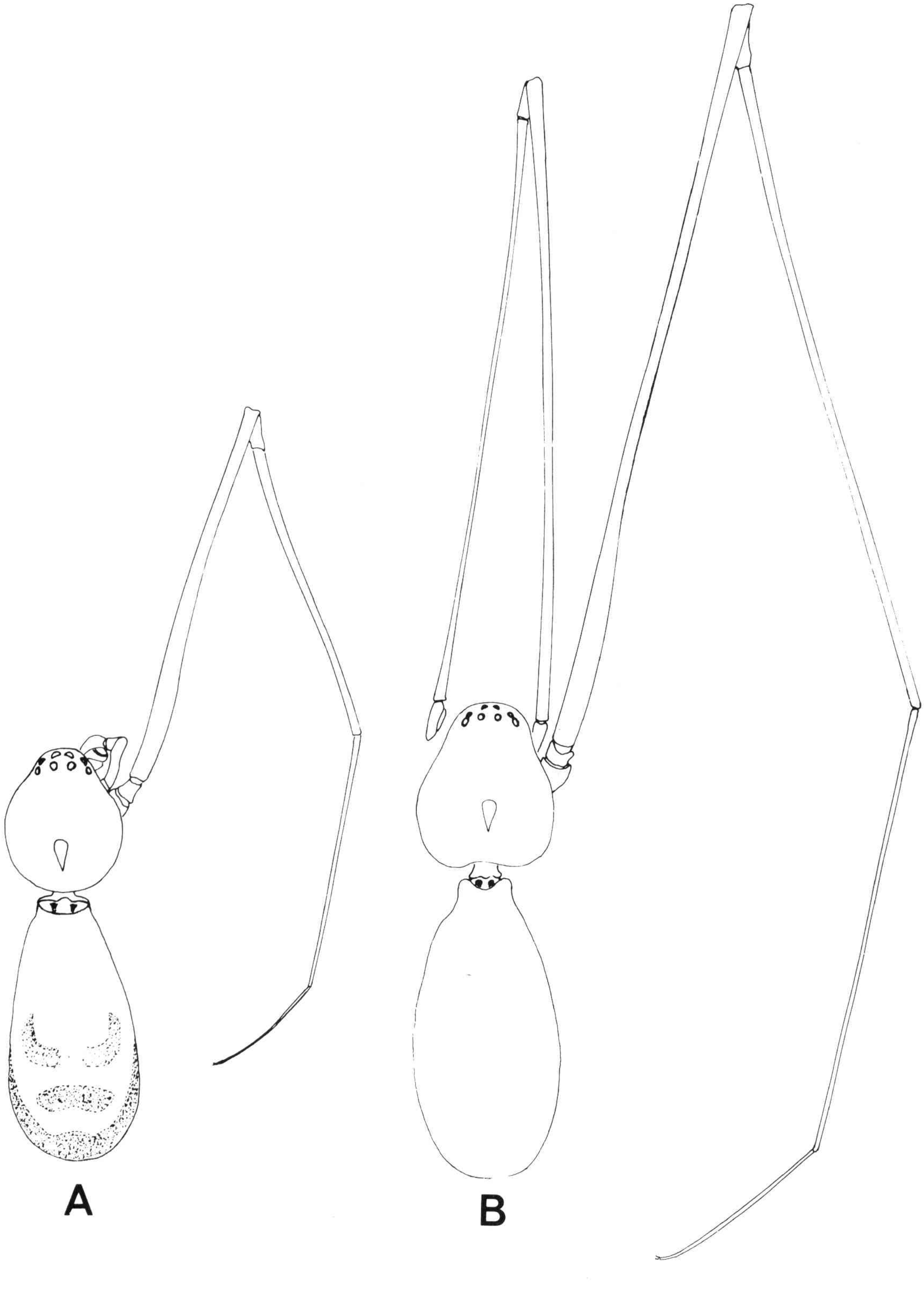

Figure 3 - Dorsal view of Synotaxus spp. showing differences in length of palp and leg I.
A - Non cave adapted troglophile ex Kaoota, Tas.
B - Cave adapted troglophile ex Wyanbene, N.S.W.

Symphtognathid spiders appear to be uncommon in caves (perhaps in part due to the difficulty of locating these tiny spiders). On the surface, some litter dwelling forest species show loss of pigment, while loss of the anterior median eyes also is not uncommon. However, the close relationship of the six-eyed symphtognathid from Loongana (Tasmania) to the eight-eyed surface species *Textricella fulva* indicates that loss of the anterior median eyes in this case is attributable to cavernicolous existence. This spider is of interest as the only spider troglobite recorded from Tasmania. Beetle troglobites, relicts of glacial periods, are relatively common in Tasmania (Moore, 1972) and it is considered likely that more spider troglobites will be found. The common cave amaurobiid, *Amphinecta* sp., and the agelenid species which may replace it in west coast caves (Figure 1), are the only other obligate troglophiles known from Tasmania. They are both probably post-glacial colonists.

The Linyphiidae is well represented in cave faunas in Europe and North America as well as Australia. Vandel (1965) notes that cavernicoles in this family are generally little specialised. The relationships of the single Australian troglobitic species are obscure at present. It is extremely specialised, lacking any trace of eyes or pigment. It is of additional interest in being the only troglobite known from Jenolan Caves (N.S.W.) where it persists in some tourist areas despite disturbance and intermittent lighting. *Synotaxus* sp. nov. A is the only spider cavernicole in which marked attenuation of the appendages has occurred (though some differential limb growth has occurred in other groups e.g. *Tartarus*).

Nullarbor troglobites

The distribution and relationships of troglobites can be of considerable interest in zoogeographic studies. The genus *Baiami* (formerly placed in *Epimecinus*) was thought to consist of species restricted to the south-west of Western Australia. However, the discovery of a closely related troglobitic genus, *Tartarus* (*T. mullamullangensis*) on the Nullarbor Plain and, subsequently of eastern forms of *Baiami* from forest habitats in South Australia and Victoria (possessing primitive morphological characters) indicates that the western species have originated from eastern stock from which they are now isolated by the dryer conditions on the Nullarbor Plain.

The presence of *T. mullamullangensis* on the Nullarbor Plain raises other questions relating to past climatic conditions. As a whole, the *Tartarus-Baiami* group is relatively moist adapted; it is not found on the surface outside the 500 mm rainfall isohyet and prefers cryptozoic, stable habitats. Presumably, the progenitor of *Tartarus* living on the surface near Mullamullang Cave (N37) would be under similar limitations. This suggests that past rainfall conditions on the southern Nullarbor Plain have been considerably wetter than the present 200-250 mm annual rainfall.

On the basis of the present species composition in southern Australia,

TABLE I : LIST OF CAVE ADAPTED SPECIES

Tp - 'advanced' troglophile; Tb - troglobite. Degree of adaptation: (x) - possible adaptation; x - slight adaptation; xx - high adaptation.

Species	Category	Reduced Pigment	Appendages Attenuated	Eyes Reduced
DIPLURIDAE:				
Troglodiplura lowryi	Tb			Blind
GRADUNGULIDAE:				
Gen. nov. sp. nov.	Tp	x	(x)	
PHOLCIDAE:				
Spermophora sp. nov. A	Tp	x		
Spermophora sp. nov. B	Tb	xx		xx
AMAUROBIIDAE:				
Amphinecta sp. nov.	Tp	x		
Tartarus mullamullangensis	Tb	xx	x	Blind
Procambridgea cavernicola	Tp	x	x	(x)
AGELENIDAE:				
Gen. nov. sp. nov	Tp	x	(x)	
MITURGIDAE:				
Janusia muiri	Tb	xx		Blind
Janusia sp. nov.	Tb	xx	x	x
(Nr. *Janusia*) sp. nov.	Tp	x	x	(x)
SYMPHYTOGNATHIDAE:				
Textricella sp. nov.	Tb	xx		x

Species	Category	Reduced Pigment	Appendages Attenuated	Eyes Reduced
LINYPHIIDAE:				
Gen. nov. sp. nov.	Tb	xx	x	Blind
Laetesia weburdi	Tp	x	(x)	
Synotaxus sp. nov. A	Tp	xx	xx	
THERIDIIDAE:				
Steatoda sp. nov. A	Tp	x		
Steatoda sp. nov. B	Tb	xx		xx
Steatoda sp. nov. C	Tb	xx		xx
Steatoda sp. nov. D	Tb	xx		x
Steatoda sp. nov. E	Tb	xx		xx
Steatoda sp. nov. F	Tb	xx		xx
Steatoda sp. nov. G	Tp	xx		x
Pholcomma sp. nov. A	Tp	xx		

the spread of some faunal groups across the Nullarbor Plain has been correlated by several authors (notably Main et al, 1959) with late Pliocene and Pleistocene climatic and eustatic fluctuations in southern Australia, the precise nature and coincidence of which remains unclear (Galloway, 1965). Presumably, the origin of *T. mullamullangensis* was associated with the drying phase of one of these climatic cycles which caused the elimination of the surface moist adapted fauna, leaving only cave isolate populations of which a very few survived and differentiated into troglobites.

While there is much debate at present about the intensity and chronology of past climatic and geomorphic events on the Nullarbor Plain (Jennings, 1967) Lowry (1964) and Hunt (1970) support a Pleistocene origin for the collapse and entrance forming phase of the Nullarbor deep caves within which spider troglobites have evolved.

Janusia muiri, the miturgid troglobite, differs from *T. mullamullangensis* in that related species are known only from eastern Australia (less advanced troglobites in Buchan-Murrindal Caves, Victoria). Its presence in two widely separated Nullarbor caves (Pannikin Plain Cave (N49) and

Weebubbie Cave (N2)) is particularly interesting and presents the alternatives of independent origin from a surface progenitor or migration by some means from a source cave. However, mature specimens are not available from Pannikin Plain Cave so it is not yet certain that the two populations are definitely conspecific despite their close similarity. This question needs to be settled before attempting to answer others regarding origin and migration.

The relationships of the mygalomorph troglobite, Troglodiplura lowryi, are obscure; no close relatives appear to remain extant. This apparent lack of related species suggests that it may be an older relict than either of the other Nullarbor spider troglobites. However, until more is known of late Tertiary and Pleistocene climatic regimes and their likely effect on cave development in the Nullarbor region, little can be said with certainty.

The Theridiid Fauna

The Theridiidae are probably the most common group in Australian caves. In part, this is simply a reflection of the frequency in surface habitats of genera such as Achaearanea, which is often found in relatively dry regions and is never cave adapted. In contrast, Pholcomma is a moist adapted genus and it is of interest to record it as an obligate troglophile in Abrakurrie Cave (N3), Nullarbor Plain. The spider is depigmented, but the eyes appear to be normal so that it is probably a recent colonist.

The Theridiidae are also common in caves in other countries but have not given rise to troglobites (Vandel, 1965). However, Australia is again atypical in possessing a remarkable group of closely related therid troglobites which have affinities with the genus Steatoda. The occurrence of relatively unmodified troglophiles (Steatoda sp. n. A) in eastern Australian caves poses a problem in giving full species status to some of the eastern cave-adapted forms. However, differences in the male palp, stridulatory organ and carapace shape suggest that at least the Cliefden (N.S.W.), Naracoorte (South Australia) and Western Australian spiders are definite species.

Unmodified troglophiles occur in New South Wales, Victoria, Tasmania and Western Australia. Cave adapted species occur in all southern states. Presumably a single progenitor species, once distributed right across southern Australia, was fragmented into cave isolate populations as a result of climatic fluctuations. Entry into caves may have occurred at different times in different areas, depending on the severity of local climatic change. This would help account for the large variations in eye regression observed between species (Figure 2). The degree of eye regression is generally considered to be a good indication of the relative ages of related cavernicoles (Mohr and Poulson, 1966). On this basis the Yarrangobilly (N.S.W.), and the Nambung River (W.A.) species are the oldest cavernicoles (Figure 2, F and G). Some specimens from the Nambung River region show complete loss of eyes (J. Lowry, pers. comm.).

TABLE 2 : COMPARISON OF THE CAVE SPIDER FAUNAS OF AUSTRALIA AND JAPAN

Australia		Japan	
Family	% of Total species	Family	% of Total species
Theridiidae	17	Leptonetidae *	19
Amaurobiidae	16	Agelenidae	12
Pholcidae	12	Arygonetidae *	10
Linyphiidae	9	Theridiidae	9
Cycloctenidae *	7	Nesticidae *	9
Mimetidae	4	Linyphiidae	7
Miturgidae *	4	Micryphantidae	5
Theridiosomatidae	4	Araneidae	3
Araneidae	3	Dictynidae	3
Lycosidae	3	Thomisidae	3
Sparassidae	3	Clubionidae	3
Dipluridae *	2	Sparassidae	3
Gradungulidae *	2	Pisauridae	2
Symphytognathidae	2	Lycosidae	2
Pisauridae	2	Pholcidae	1
Zodariidae	2	Oonopidae	1
Clubionidae	2	Symphytognathidae	1
Ctenidae	2	Mimetidae	1
Uloboridae	1	Uloboridae	1
Agelenidae	1	Oxyopidae	1
Hickmaniidae *	1	Oecobiidae	1
Ctenizidae	1	Filistatidae	1
		Antrodiaetidae *	1
		Heptathelidae *	1

* - Family not represented in Japan / Australia

Figure 4 - Geographic distribution of spider troglobites and the caves in which they occur.

The presence of a spider troglobite in the Yarrangobilly Caves is notable since no troglobites were previously known from the southern highland caves despite their apparent suitability as glacial refuge areas. The nearby Cooleman Caves (N.S.W.) harbour only the unmodified *Steatoda* sp. A and lack any other cave adapted fauna. Nevertheless, both the Cooleman and Yarrangobilly areas show evidence of periglacial activity. Moore (1972) suggests that the absence of troglobites at Cooleman could be a result of dryer conditions in these caves during Recent times. Alternatively, the severity of Pleistocene glacial climates and periglacial solifluction may have prevented effective colonisation.

General distribution and age of Australian troglobites

It is notable that the distribution of spider troglobites (Figure 4) is almost entirely southern (below 30° south latitude) and is more extensive than that of other invertebrate groups (notably insects) which are largely confined to the heavily glaciated Tasmanian region. To account for the lack of troglobites in such groups, particularly in the numerous cave systems of south-east Australia, various authors have suggested that dryer post-Pleistocene climates (if they occurred) may have caused the extinction of much of the older mainland cave fauna. The spider troglobites from south-east Australia are represented by a linyphiid from the Jenolan Caves (N.S.W.), a miturgid from the Buchan-Murrindal Caves (Victoria), and the widely distributed '*Steatoda* group'. The great size of the Jenolan Caves probably ensured the survival of the linyphiid during dryer periods. However, the success of the '*Steatoda* group' may be linked to their suggested derivation from a weakly hygrophilic surface group (*Steatoda*) which is common in woodland and grassland habitats. This suggests that such cavernicoles could be better able to withstand a period of reduced moisture in caves than would troglobites derived from strongly hygrophilic groups.

As noted above, precise isotopic dating of igneous rocks provides a potentially valuable tool for the approximation of the age of lava cave troglobites and, by inference, of related limestone cave troglobites also.

The oldest date recorded for the Newer Volcanics in both south-western Victoria and northern Queensland is about 4.5 million years though many are much younger, the range being 4.5 to 0.5 million years (Wyatt and Webb, 1970; Aziz-Ur-Rahman and McDougall, 1972). Unfortunately, precise dates are not yet available for the cavernous lavas from which spider troglobites are presently recorded (Mt. Widderin Cave (H1), Skipton, Vic.; Barker's Cave, Mt. Surprise, Qld.) but, considering their present state of preservation, they (and their troglobites) are probably much younger than 4.5 million years.

The use of isotopic dating has shown that the climatically and stratigraphically and faunally defined boundaries between Cainozoic periods can differ markedly (McDougall and Stipp, 1968). At present, the most reliable estimate for the Miocene-Pliocene boundary is about 5.5 million years while the Pliocene-Pleistocene boundary is placed at about 1.8 million years (Aziz-Ur-Rahman and McDougall, 1972).

As a general proposition, it seems likely that the major event which resulted in the prolonged isolation and consequent differentiation of potential troglobites in caves (particularly in the southern part of Australia, Figure 5) was the onset of cyclic glacial-interglacial phases. Isotopic dating places the onset of marked climatic cooling resulting in glaciation at 2.5 - 3.0 million years ago in middle latitudes (McDougall and Stipp, 1968) i.e. mid-late Pliocene. It is suggested here that this date may represent at least an approximate upper limit of the age of Australian spider troglobites; some may be much younger as suggested by the grades of differentiation observed.

RELATIONSHIPS WITH OTHER FAUNAS

A great deal of taxonomic and ecological work is required before our knowledge of the Australian cave spider fauna is comparable to that of Northern Hemisphere faunas. A comparison with one of these faunas, that of Japan, is given in Table 2. The data for the Japanese fauna (Yaginuma, 1962, 1972 and Komatsu, 1970) are not complete, but give a fairly accurate idea of the composition of that fauna.

Cave adapted species appear to be more common in the Japanese fauna. For example, a review by Yaginuma (1962) lists over half the recorded species as troglobites. The majority of Japanese troglobites are placed in families which do not occur in Australia (Leptonetidae, Arygonetidae, Nesticidae), or are poorly represented (Dictynidae, Agelenidae). A comparable situation occurs in the Australian fauna with regard to the families Miturgidae and Dipluridae (absent from Japan) and the Amaurobiidae (poorly represented in Japan). Families such as the Agelenidae, Arygonetidae and Dictynidae in Japan can be regarded as broad ecological equivalents of groups such as the Miturgidae and Amaurobiidae in Australia. More specifically, a comparison of the '*Steatoda* group' of troglobites in Australian caves with the Nesticidae in Japanese caves indicates a close ecological affinity between them.

Interestingly, there appears to be no Australian spider equivalent of the commonest Japanese cave spiders - the small, foraging leptonetids. It seems likely that their niche is occupied by the relatively abundant pseucoscorpion fauna in Australian caves.

As noted above, the occurrence in Australia of troglobites in the Theridiidae and Pholcidae is atypical. In other faunas, these groups occur only as unmodified troglophiles. At present the widely distributed linyphiids appear to be the only group with troglobitic representatives in both the Australian and Northern Hemisphere faunas.

CONSERVATION

As our cave faunas become better known, it is increasingly obvious that certain cave systems contain unique faunas that should be given some measure of protection beyond "tourist reserve" status. All caves containing troglobitic faunas should be protected (not a great number) as well as caves selected as representative of particular faunal types. The latter is certainly necessary.

Overuse of caves by speleologists or encroachment by commercial interests are problems faced by a number of important caves at present. One example of the former is the detrimental effect which caving activity has had on the small and remote Dome Chamber (Mullamullang Cave, N37) population of the Nullarbor troglobite T. mullamullangensis since its original discovery by the author and B. Muir in 1967. Groups visiting Mullamullang Cave usually make the Dome Chamber the prime objective. Most cavers are probably unaware of the presence of the spider, and the relatively large amount of activity in this small chamber has resulted in considerable and continuing web destruction (the webs are often built low down around the walls or in the rockpile). A reduction in usage and disturbance here is essential. Ideally, this should apply to the whole cave environment because the attenuated food chain upon which this troglobite depends for survival includes troglophilic species whose main populations are much nearer the surface. Depletion of these species could cause the elimination of T. mullamullangensis.

Another cave worthy of protection is Carrai Bat Cave in northern N.S.W. It is scientifically important because of its gradungulid spider population and the long-term studies of bat populations and guanobia carried out there (Dwyer, 1965; Harris, 1973). Nearby, at Kempsey (N.S.W.), limestone mining operations threaten the Yessabah caves which contain both a large trapdoor spider population and extensive Recent bone deposits.

Attempts are currently being made by the Australian Speleological Federation to prepare a specific needs program for cave conservation. An application for reserve status for Mullamullang Cave has already been submitted.

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APPENDIX I - LIST OF CAVE SPIDER FAUNA

Mygalomorpha

Family DIPLURIDAE - *Troglodiplura lowryi* Main, Roaches Rest Cave (N58), Nullarbor Plain, W.A.: *Atrax* sp. nov., * (south coast robustus group), ? Cave, E. Buchan, Vic.

Family CTENIZIDAE - *Dyarcyops* sp. nov., Yessabah Bat Cave (KY1), Kempsey, N.S.W.

Hypochilomorpha

Family GRADUNGULIDAE - Gen. nov. sp. nov., Carrai Bat Cave (KS5), Carrai, N.S.W.: *Gradungula* sp. nov. *, Paradox Cave, Jenolan, N.S.W.; Gable Cave (CL7), Cliefden, N.S.W.; River Cave (Y27), Yarrangobilly, N.S.W.

Family HICKMANIIDAE - *Hickmania troglodytes* * (Higgins and Pettard), Cairn Crawl Cave, Lorinna, Tas.; King George V Cave, Newdegate Cave, Hastings, Tas.; Baldock's Cave, Diamond Cave, Mole Creek, Tas.

Araneomorpha

Family PHOLCIDAE: Pholcinae - *Physocyclus* sp. nov. A, Elephant Hole (E8), Mt. Etna, Qld.: *Physocyclus* sp. nov. B, Unnamed cave, Wombat Creek, Vic.; ? Colong Cave, Yerranderie, N.S.W.: *Physocyclus* sp. nov. C *, Mullamullang Cave (N37), Kestrel No. 1 Cavern (N40), Spider Sink (N41), Horseshoe Cave (N59), Nullarbor Plain, W.A.: *Physocyclus* sp. nov. D *, Old Napier Downs Cave, Napier Range, W.A.: *Pholcus ancoralis* * L. Koch, Royal Arch Cave (CH9), Chillagoe, Qld.: *Pholcus litoralis* * L. Koch, Cave KK1, Kunderang, N.S.W.: *Spermophora* sp. nov. A, 4 mile Cave, Camooweal, Qld.; *Spermophora* sp. nov. B, Barker's Cave, Mt. Surprise, Qld.: Smeringopinae - *Smeringopus tipuloides* * (L. Koch), Tick Cave (E14), Mt. Etna, Qld.: Blechroscelinae - *Psilochorus sphaeroides* * L. Koch, Cangai Copper Mine, Cangai, N.S.W.: *Psilochorus* sp. nov., Yessabah Bat Cave (KY1), Kempsey, N.S.W., Carrai Bat Cave (KS5), Windy Gap, N.S.W.

Family AMAUROBIIDAE: Desinae - *Ixeuticus socialis* Rainbow, Jenolan Caves, Jenolan, N.S.W.: *Forsterina annulipes* * (L. Koch), Johansens' Cave, Mt. Etna, Qld.: *Forsterina* sp. nov. Cave KK4, Kunderang, N.S.W.: Amphinectinae - *Epimecinus alkirna* Gray, Cocklebiddy Cave (N48), Pannikin Plain Cave (N49), Abrakurrie Cave (N3), Mullamullang Cave (N37), Weebubbie Cave (N2), Spider Sink (N41), Horseshoe Cave (N59), Nullarbor Plain, W.A.: *Epimecinus* sp. nov., Cotter Cave, A.C.T.; Mabel Cave (EB1), Buchan, Vic.: Gen. nov. sp. nov., Cave E17, Mt. Etna, Qld.: *Amphinecta* sp. nov., Cashion

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* Also known from surface habitats.

Creek Cave, Frankcombie Cave, Florentine Valley, Tas.; King George V Cave, Hastings, Tas.; Exit Cave, Ida Bay, Tas.; Baldock's Cave, Scott's Cave, Mole Creek, Tas.: Stiphidiinae - *Stiphidion facetum* * Simon, Baldock's Cave, Mole Creek, Tas.; Lucas Cave (J7), Jenolan, N.S.W.: Fossil Cave (B4), Drum Cave (B13), Bungonia, N.S.W.; Colong Cave, near Yerranderie, N.S.W.; Basin Cave, Fig Tree Cave, Wombeyan, N.S.W.; Grotto Cave (Y30), Unnamed cave, Yarrangobilly, N.S.W.; Punchbowl Cave, Wee Jasper, N.S.W.: *Tartarus mullamullangensis* Gray, Mullamullang Cave (N37), Nullarbor Plain, W.A.: *Baiami tegenarioides* * (Simon), Calgardup Cave (WI49), Arumvale Cave (WI57), Strong's Cave (WI63), Witchcliffe, W.A.; Conference Cave, Connolly's Cave (WI48), Margaret River, W.A.; Easter Cave (AU14), Augusta, W.A.: *Baiami volucripes* * (Simon), Census Cave (YN26), Mambiddy Cave, Yanchep, W.A.; Turbane Cave, Nambung River, W.A.: *Procambridgea cavernicola* Forster, Punchbowl Cave, (WJ8), Wee Jasper, N.S.W.; Basin Cave, Fig Tree Cave, Wombeyan, N.S.W.: Gen. nov. sp. nov. *, Carrai Bat Cave (KS5), Col's Cave, Windy Gap; Yessabah Bat Cave (KY1), Kempsey, N.S.W.: Amaurobiinae - *Storenomorpha* sp. *, Fossil Cave (B4), Bungonia, N.S.W.

Family AGELENIDAE - Gen. nov. sp. nov., Tiny's Watch Hole, Bub's Hill, Tas.

Family MITURGIDAE - *Janusia muiri* Gray, Weebubbie Cave (N2), Pannikin Plain Cave (N49), Nullarbor Plain, W.A.: *Janusia* sp. nov., Trogdip Cave (EB10), Mabel Cave (EB1), E. Buchan, Vic.; Anticline Cave (M11), Dalley's Sinkhole (M35), Murrindal, Vic.: Gen. nov. (near *Janusia*) sp. nov., Cave KK4, Kunderang, N.S.W.; Col's Cave, Windy Gap, N.S.W.

Family CTENIDAE - *Thasyrea lepida* * L. Koch, Grotto Cave (Y30), Yarrangobilly, N.S.W.: *Argoctenus* sp., Baldock's Cave, Mole Creek, Tas.

Family SPARASSIDAE - *Heteropoda procera* * L. Koch, Comboyne Caves (KC1), Comboyne, N.S.W.; Carrai Bat Cave (KS5), River Cave (KS1), Col's Cave, Queensland Cave, Windy Gap, N.S.W.; Yessabah Caves, Kempsey, N.S.W.: *Heteropoda* sp., Barker's Cave, Mt. Surprise, Qld.; Johansen's Cave, Tick Cave (E14), Mt. Etna, Qld.: *Olois pictus* * L. Koch, Grotto Cave, (Y30), Yarrangobilly, N.S.W.: *Isopeda saundersi* * Hogg, Horseshoe Cave (N59), Nullarbor Plain, W.A.

Family CLUBIONIDAE - *Clubiona* sp. *, Six Mile Cave, Nullarbor Plain, W.A.; Gen. nov. sp. nov. *, Golgotha Cave, (WI13), Witchcliffe, W.A.

Family ZODARIIDAE - *Storena graeffi* * (Koch), Horseshoe Cave (N59), Nullarbor Plain, W.A.

Family PISAURIDAE - Undet. juveniles, Comboyne Cave (KC1), Comboyne, N.S.W.; Carrai Bat Cave (KS5), Windy Gap, N.S.W.; Cangai Copper Mine, Cangai, N.S.W.

Family CYCLOCTENIDAE - Cycloctenus abyssinus * Urquhart, Jenolan Caves, Jenolan, N.S.W.; Main Cave, Tuglow, N.S.W.; Grill Cave (B9), Bungonia, N.S.W.: Cycloctenus sp. nov. A, Wyanbene Cave (WY1), Braidwood, N.S.W.: Cycloctenus sp. nov B, Nargun's Cave (NN1), Nowa Nowa, Vic.; Hope's Cave (EB14), E. Buchan, Vic.; ? Cave, Limestone Creek, Vic.; ? Cave, Stony Creek, Vic.; Snowflake Cave (S1), Glenelg River, S.A.: Cycloctenus sp. nov. C, Ranga Cave, Flinders Island, Tas.: Toxopsiella sp. nov. A *, Chalk Cave (B?), Bungonia, N.S.W.; Gable Cave (CL7), Cliefden, N.S.W.: Toxopsiella sp. nov. B *, Carrai Bat Cave, (KS5), Windy Gap, N.S.W.; Yessabah Bat Cave (KY1), Kempsey, N.S.W.

Family LYCOSIDAE - Lycosa speciosa * L. Koch, Carrai Bat Cave (KS5), Windy Gap, N.S.W.: Lycosa sp. *, Haig Cave (N55), Madura Cave (N62), Nullarbor Plain, W.A.: ? Arctosa sp., Lynch Cave, (N60), Nullarbor Plain, W.A.

Family MIMETIDAE - Ero tasmaniensis * Hickman, Ranga Cave, Flinders Island, Tas.: Mimetus maculosus * Rainbow, Jenolan Caves, Jenolan, N.S.W.; Yessabah Bat Cave (KY1), Kempsey, N.S.W.: Mimetus spp., Grill Cave (B9), Bungonia, N.S.W.; Spiral Staircase Cave (3), Indi, Vic.; Grotto Cave, (Y30), Yarrangobilly, N.S.W.; Trogdip Cave (EB10), E. Buchan, Vic.; ? Cave, Wombat Creek, Vic.

Family ARANEIDAE - Orsinome sp. nov., River Cave (KS1), Windy Gap, N.S.W.; Spiral Staircase Cave (I3), Indi, Vic.; Nargun's Cave (NN1), Nowa Nowa, Vic.: Orsinome spp, Diamond Cave, Mole Creek, Tas.; Golgotha Cave (WI13), Wichcliffe, W.A.

Family ULOBORIDAE - Uloborus pantherinus * Keyserling, Lucas Cave, (J7), Jenolan, N.S.W.; Grill Cave (B9), Bungonia, N.S.W.

Family SYMPHYTOGNATHIDAE - Micropholcomma longissima * (Butler), Chifley Cave (J2), Jenolan, N.S.W.: Textricella sp. nov., Old Tourist Cave, Loongana, Tas.

Family THERIDIOSOMATIDAE - Gen. nov. sp. nov A, Yessabah Bat Cave (KY1), Kempsey, N.S.W.; Cave KK4, Kunderang, N.S.W.; Col's Cave, Carrai Bat Cave (KS5), River Cave (KS1), Queensland Cave, Windy Gap, N.S.W.; Gen. nov. sp. nov. B, Abercrombie Cave, Abercrombie, N.S.W.; Grill Cave (B9), Bungonia, N.S.W.; Jenolan Caves, Jenolan, N.S.W.; Tuglow Caves, Tuglow, N.S.W.; Wombeyan Caves, Wombeyan, N.S.W.; Snowflake Cave (S1), Glenelg River, S.A.: Gen. nov. sp. nov. C, Arumvale Cave (WI57), Witchcliffe, W.A.

Family LINYPHIIDAE - Laetesia leo van Helsdingen, Koonalda Cave (N4), Nullarbor Plain, S.A.: Laetesia mollita * Simon, Insect Cave, Mt. Hamilton, Vic.; Super Cave (Sh1), Nambung River, W.A.; Tumbledin Cave (J8), Green Head, W.A.: Laetesia weburdi (Urquhart), Jenolan Caves, Jenolan, N.S.W.: Gen. nov. near Laetesia, Unnamed cave, Yarrangobilly, N.S.W.: Ostearius melanopygius * (O.P. Cambridge), Insect Cave, Mt. Hamilton, Vic.: Gen. nov. sp. nov., River Cave (J10), Imperial Cave (J4), Jenolan, N.S.W.: Synotaxus sp. nov A, Wyanbene Cave (WY1), Braidwood, N.S.W.: Synotaxus sp. nov. B, Sandfly Colliery, Kaoota, Tas.

Family THERIDIIDAE - Achaearanea extrilidum * (Keyserling), Yessabah Bat Cave (KY1), Kempsey, N.S.W.; Unnamed cave, Grotto Cave (Y30), Yarrangobilly, N.S.W.: Achaearanea sp., Holy Jump Cave, Bauer's Mountain, Qld.: Achaearanea spp. nov. * (properum group), Carrai Bat Cave (KS5), Col's Cave, Windy Gap; Yessabah Caves (KY1 & 2), Kempsey, N.S.W.; Pub Paddock Cave, Gran Gran, S.A.; Cocklebiddy Cave (N48), Mullamullang Cave (N37), Abrakurrie Cave (N3), Weebubbie Cave (N2), Spider Sink (N41), Six Mile Cave, Nullarbor Plain, W.A.; Calgardup Cave (WI49), Witchcliffe, W.A.: Latrodectus hasseltii * Thorell, Koomooloobooka Cave (N16), Roaches Rest Cave (N58), Lynch Cave (N60), Madura Cave (N62), Nullarbor Plain: Enoplognatha sp. nov., Nargun's Cave (NN1), Nowa Nowa, Vic.; Chimney Cave, Portland, Vic.: Steatoda sp. nov. A, River Cave (KS1), Windy Gap, N.S.W.; Timor Caves, Timor, N.S.W.; Mammoth Cave (J13), Jenolan, N.S.W.; Fossil Cave (B4), Bungonia, N.S.W.; Black Range Cave (CP12), Cooleman, N.S.W.; Hope's Cave (EB14), E. Buchan, Vic.; Dalley's Sinkhole (M35), Murrindal, Vic.; Nargun's Cave (NN1), Nowa Nowa, Vic.; Ranga Cave, Flinders Island, Tas.; Maracoopa Cave, Mole Creek, Tas.: Steatoda sp. nov. B, Gable Cave (CL7), Cliefden, N.S.W.: Steatoda sp. nov. C, River Cave (Y27), Tricketts Cave (Y13), Yarrangobilly, N.S.W.: Steatoda sp. nov D, Mt. Widderin Cave (H1), Skipton, Vic.: Steatoda sp. nov. E, Sand Funnel Cave (S29), Naracoorte, S.A.: Steatoda sp. nov. F, Quandong Cave (SH12), Nambung River, W.A.: Steatoda sp. nov. G, Strong's Cave (WI63), Golgotha Cave (WI13), Witchcliffe, W.A.: Pholcomma sp. nov. A, Abrakurrie Cave (N3), Nullarbor Plain, W.A.: Pholcomma sp. nov. B, Mambiddy Cave, Yanchep, W.A.

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ABSTRACTS AND REVIEWS

GEOLOGY OF THE WESTERN AUSTRALIAN PART OF THE EUCLA BASIN. By D.C. Lowry. Geological Survey of Western Australia Bulletin 122. 1970. Pp 201 + a large, folded, coloured, bound-in geological map of the Eucla Basin in Western Australia. (Although dated 1970, this publication does not appear to have been published until 1972.)

The Eucla Basin, more commonly known as the Nullarbor Plain, is mostly an arid limestone plateau which forms a desolate barrier between the southern part of Western Australia and the eastern part of Australia. The Basin covers 88,000 sq. miles of land of which about 23,000 lies in South Australia and 65,000 in Western Australia. Only the WA part of the Basin is considered in the Report. The Basin slopes gently seawards from an altitude of 800 ft in the north (where it grades into the Great Victoria Desert) to 200-390 ft in the south where it terminates abruptly in rugged limestone cliffs. In places the cliffs are swept by the sea, in other places the cliffs are now separated from the sea by a low coastal plain. The plateau is dotted with numerous small caves and several large ones that reach down to the watertable some 250-350 ft below the surface. On the whole, karst development has been retarded by the aridity and low initial relief.

In this Bulletin, the author presents a complete geological description which comprises the first regional investigation of the area. Chapters cover physiography, stratigraphy, diagenesis, structure, geological history and economic geology. The geological map will prove of great value to the speleologist as well as the geologist. It shows the position of a large number of caves between about 123 deg. E and the WA/SA border. References to caves and collapse dolines are scattered throughout the Report and include, for example, a section dealing with classification of the Eucla Basin limestone caves into four categories each named after a typical example (Cocklebiddy, Thylacine, Nurina and Gecko types). Another classification is Collapse Doline. Lowry also mentions another Nullarbor feature of speleological interest - Blow-holes. These are circular, vertical shafts opening to the surface and notable for the strong air draughts that commonly blow through them. They are usually about 1-6 ft diameter and 5-35 ft deep. They sometimes lead to accessible caves. Lowry says there are many thousands on the plateau in WA alone, although only a small fraction lead to cavities large enough for a man to enter. Opinions differ as to their origin. Some of these blow-hole draughts are quite substantial and I have seen birds trapped in caves accessible by blow-hole only trying desperately to fly out against an inward air current, only to be swept back into the cave.

The whole Report is significant for the speleologist, with many of the sections of special interest, e.g., age of caves, marsupial bone-bearing cave deposits, the occurrence and salinity of the underground water, the cave areas, comments on cave lakes, etc. Two Appendices are included. Tertiary Echinoids by G.M. Philip and Cheilostomatous Bryozoa by A.E. Cockbain. Many of the specimens were collected from caves in the area. - E.A.L.