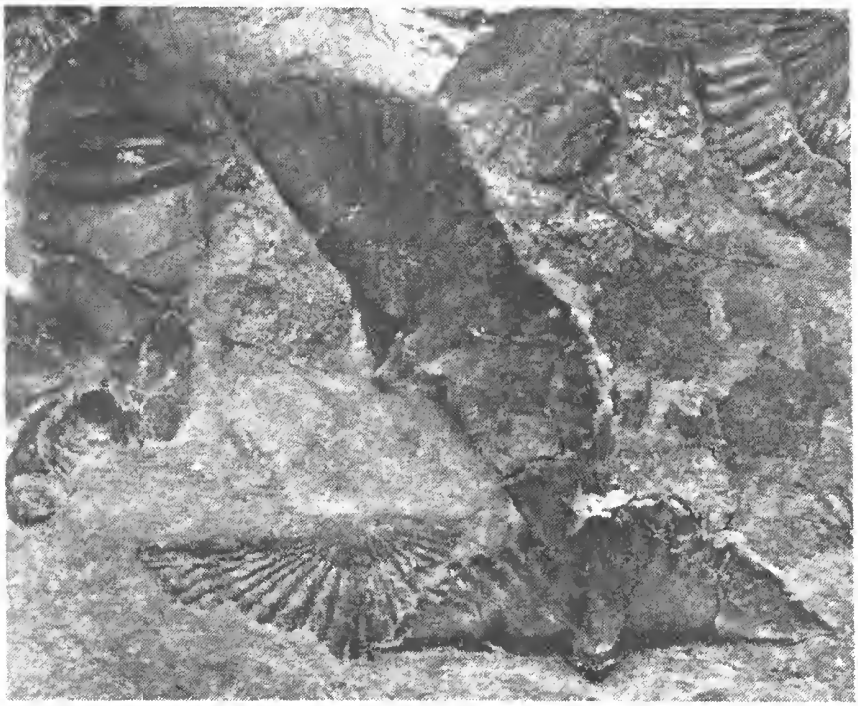
THE FOSSIL COLLECTOR

BULLETIN Nº 43 MAY 1994



Permian brachiopods, Ulladulla, N.S.W.

Published by
THE FOSSIL COLLECTORS ASSOCIATION OF AUSTRALASIA

ISSN 1037-2997

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CONTENTS

EDITORIAL NOTES

AGAIN A QUESTION OF SURVIVAL

This is the first time in 10 years in which we have not been able to meet our arbitrary target of at least 28 pages per issue. In fact, but for the efforts of two people who both contributed two articles, Ken Bell and Alan Goldstein (USA), it would not have been worth printing this issue of The Fossil Collector. While we could resort to reprinting interesting articles from eariier Bulletins or (with permission) from other magazines, we believe this would be a retrograde step especially since we have built up a reputation for publishing predominately original material.

Perhaps after 15 years we have exhausted the goodwill of both our members and professional friends alike. After all we are a non-profit making amateur group and cannot expect outside sources to provide endless copy without payment.

While it is proposed to continue at least to the end of the Association's financial year (February, 1995) it may then be necessary to seriously consider ceasing publication, unless someone else is prepared to take over the Editing and running of the Association, and some sort of assurance can be obtained that adequate material will be available to justify further publication. After 45 issues the current Secretary/Editor would like to take a break!

DEADLINE FOR NEXT ISSUE

Material for the next issue should be submitted by 22nd August, 1994, unless otherwise arranged with the Editor.

OVERSEAS COLLECTORS WISHING TO EXCHANGE FOSSILS

Scott Taylor, 9744 Forest Lane #1714, Dallas, Texas 75243-5749, **USA**, is interested in exchanging fossils with FCAA members. Anyone wishing to correspond should include a general list of what they have to offer as well as what they would like to obtain. Scott's collecting is primarily limited to the Cretaceous and Pennsylvanian (Late Cretaceous) of Texas.

Isidro Gurrea, Blesa 43, 1-1, 08004 Barcelona, **Spain**, would also like to trade with Australian collectors. Isidro can offer fossils from Spain and western Europe as well as some typical Spanish mineral specimens. His main interests are in echinoids, ammonites,gastropods and trilobites.

[Members sending fossils out of Australia are reminded that a permit is required from the Heritage Protection Section, Department of Arts and Administrative Services, GPO Box 1920, Canberra, ACT 2601.]

OBITUARIES

It is with deep regret that I have to report that two long standing members of the FCAA, **Mrs S. M. Fowler** of Mt Isa, Queensland, and **Mrs Iris Ridding** of Dapto, NSW, have recently passed away. Mrs Fowler had been a member virtually since the Association's inception, having joined in December, 1980; while Mrs Ridding joined joined 10 years ago. Our sincere condolencies to their families: both ladies were keen collectors and will be sadly missed by their friends.

ADVERTISING RATES

As from the 1st March, 1994, the following advertising rates apply:

FULL PAGE	$24.00	QUARTER PAGE	$10.00
HALF PAGE	$16.00	EIGHTH PAGE	$6.00

Additional costs for art work and reproduction of photographs will be quoted on application. Members may place personal advertisements not exceeding 50 words (approx. 4 lines) free of charge.

FINANCES

Income and expenditure for the Financial Year, 1st March, 1993 to 28th February, 1994 (previous year's income and expenditure shown in brackets).

INCOME			EXPENDITURE		
Subscriptions			Postage	873.50	(908.38)
current	1036.00	(1147.00)	Printing	602.38	(568.65)
advance	808.62	(776.33)	Photocopies,		
Donations	23.00	(24.60)	photo's & bromides	105.60	(174.60)
Advertising	40.00	(30.00)	Stationery	173.60	(71.14)
Bank interest	53.12	(62.43)	Sundries	119.65	(170.51)
Sale of Bulletins	151.66	(217.15)	State Rep. expenses	9.20	(56.69)
Miscellaneous	-	(-)	Donation (Save Eric)	250.00	(-)
			State/Fed. tax	6.20	(3.87)
			Miscellaneous	13.50	(-)
			WP purchase (50%)	-	(22.50)
	$2,112.40	(2,257.51)		$2,153.63	(1,976.34)

Balance at 28th February, 1994		
Brought forward from	1992/1993	$2,111.86
Add income	1993/1994	$2,112.40
		$4,224.26
Less expenditure	1992/1993	$2,153.63
		$2,070.63

When the above figures are adjusted to include 1993/94 subscriptions paid in 1991/92, and 1992/93 ($755.83) and to exclude 1994/95 and 1995/96 subscriptions paid in advance ($808.62), expenditure for the Financial Year 1993/1994 exceeded income by $94.02 compared with a surplus of $248.65 for the previous year. After deducting total advance subscriptions of $841.62 from the balance in hand at 28th February, 1994, we are left with a net reserve of $1,229.01 ($1,323.03).

Assets are valued at approximately $720.00 (these include part ownership of a Word Processor [50%], stationery, staplers and back issues of Bulletins etc.). At 28th February, 1994, there were no liabilities.

AUSTRALASIAN PALAEONTOLOGICAL CONVENTION - 94

Ken Bell, Stony Creek, South Gippsland, Victoria.

The Australasian Palaeontological Convention - 94 (sponsored by the Australasian Association of Palaeontologists and hosted by Macquarie University Centre for Eco-stratigraphy and Palaeoecology) was held from February 7-9. Approximately 140 took part in the talkfest which ranged from Precambrian micro-organisms through micro- and macro-vertebrates, to a wide variety of invertebrate fossils, as well as subjects such as palaeoecology, stratigraphy and aspects of animal behaviour. Participants came from all Australian States, N. Z., South Africa, Russia, Czech Republic, England and the Netherlands. There were five keynote presentations on topics as diverse as Zircon calibration of the Late Palaeozoic (J. Roberts), polar dinosaurs (P. Vickers-Rich), Palaeozoic thermal spring biology as a guide to fossil life on Mars (M. Walter), the extensive and ancient radiation of Peripatus (N. Tait) and M. Archer on some vertebrates in the Tertiary of Oz. These were accompanied by some 51 other oral presentations, 27 posters and 5 workshops! Needless to say, no attempt will be made to summarize them all.

After the official welcoming, Malcolm Walter (Macqu. U.) started the proceedings by discussing the hydrothermal ecosystems that have existed (and still do) on Earth. These thermal spring deposits contain a palaeontological record, and as a thermophilic beginning has been proposed for the origin of life on Earth and since Mars may also have had a similar early history, there is the possibility that ancient thermal spring deposits could contain clues to early Martian life.

Kath Grey (Macqu. U.) outlined the stratigraphic usefulness of Pre-Cambrian (Neoproterozoic) acritarchs from the Centralian Superbasin - some 80 species are represented which have enabled a fourfold biostratigraphic zonation to be proposed. Kaye Cotter (Macqu. U.) discussed preliminary results on the microfossils from cherts in the Officer Basin (Neoproterozoic) which indicate a low diversity fauna of probable marine intertidal conditions.

James Gehling (U. of S. Aust.) developed the Ediacaran theme in discussing the stratigraphic context of the fauna in Australia, U. S. A. and Namibia, stating that the classic Ediacaran taxa are confined to the ultimate and penultimate stratigraphic sequences of the terminal Neoproterozoic with no evidence for sudden extinction at the Precambrian/Cambrian boundary. He also discussed the morphology of Dickinsonia, Ernietta, Pteridinium and Phyllozoon, showing that Dickinsonia is best regarded as an annelid or arthropod-type, differing from the others which possibly have "algal" rather than animal affinities. Mary Wade (Qld. Mus.) discussed the morphology and growth of Dickinsonia costata, the commonest Precambrian animal.

Aspects of chronostratigraphy and chemostratigraphy were discussed by John Roberts (U. NSW), John Shergold (AGSO), Anita Andrew (CSIRO), Rick Morante (Macqu. U.) and Clinton Foster (AGSO). Relative time scales can be accurately found using the SHRIMP ion probe in dating small parts of zircons (Roberts); Shergold pointed out that recent SHRIMP ages have given firmer basis for the definition of the Precambrian/Cambrian boundary and for the Tommotian stage, and, based on Tasmanian dates the Cambrian/ Ordovician boundary is now placed at 490 Ma but may be younger. These datings have also shown that extensive time intervals are unrepresented in the stratigraphic record e.g., between the Early Cambrian, Manykaian and Tommotian stages where there may be a 5 Ma hiatus. Using isotope studies (carbon-13 and oxygen-18), Andrew and coworkers have studied the changing climates during the mid-Palaeozoic in Europe and Australia that are associated with some of the global extinction events and found that in many cases the changes in carbon-13 values show short-lived depletions which may reflect the swiftness/shortlived nature of these events. Using carbon-13 isotope changes, Morante showed that in both marine and nonmarine sections in Australia there is a negative change at the Permian/Triassic boundary as is known to occur in China, Austria and Spitzbergen; this large shift (about 10 parts/thousand) may be due to a high input of carbon-12 (as carbon dioxide) from either oxidation of exposed organic facies or by volcanic eruptions.

Biostratigraphy of brachiopods and trilobites in N.S.W. (Sherwin, GSNSW), corals in the Canning Basin (Brownlaw, U. Qld.), Triassic conodonts (Nichol, AGSO) and Jurassic ammonites of N. Z. (Grant- Mackie, U. Auckland) were discussed.

Vertebrate palaeontology was covered in keynote talks by M. Archer on some of the more unusual (and usually small) remains recently found, and by Pat Vickers-Rich, on our Antarctic polar dinosaurs, who pointed out that Southern Australia in the early Cretaceous acted as a refuge for some groups, allowing them to live beyond the times in which they became extinct elsewhere in the world. Other macrovertebrate groups discussed were Devonian fish of Antarctica (J. Long, W.A. Mus), Carboniferous sharks in Australia (S. Turner) where genera and even species may be similar to those in the Northern Hemisphere, and the dimorphism in jaw bones (in thickness, strength and numbers of teeth) of the theropod Allosaurus fragilis

AUSTRALASIAN PALAEONTOLOGICAL CONVENTION - 94 (Cont.)

- the robust forms are attributed to females. Paul Willis described a most interesting use of the medical CAT scanning techniques in which an unprepared skull of an Eocene crocodile was scanned and reconstructed in 3-D enabling relative bone positions and conditions to be seen and thus aid in later preparation of the specimen.

Invertebrate fossils were covered by papers on conodonts, brachiopods (Silurian, Devonian, Permian and Tertiary), corals, ammonites, ostracods, chitinozoans and echinoids (with P. Irwin, [Deakin U.] reporting a new genus of Clypeasteroidea from the Victorian Tertiary).

Poster presentations included an overview of the Pentoxylaea (S. Bennets); several on micro-vertebrate remains (usually fish bits); Devonian inarticulate brachiopods; a septate gastropod from the Silurian of N.S.W.; trace fossils of the Sydney Basin; Silurian-Devonian conodonts of Queensland; and early Carboniferous ostracods from the Bonaparte Basin.

The conference was voted an overwhelming success by all and full credit and acknowledgement must be given to the organising committee consisting of Glen Brock, Alison De Pomeroy, Ruth Mawson, John Talent, Theresa Winchester-Seeto and Gavin Young.

[It is proposed to publish papers presented at the Convention in a Memoir of the Association of Australasian Palaeontologists.]

IN THE NEWS

ANTARCTIC DINOSAUR FIND

Fossilised remains found on the icy slopes of Mount Kirkpatrick about 650 km from the South Pole, belong to a new genus of dinosaur whose most distinctive feature was a bony crest rising above its brow.

The dinosaur skeleton was found by paleontologist Dr William Hammer from Augustana College, Rock Island, Illinois, and his colleagues, during an expedition to Antarctica in 1990. Dr Hammer was able to ship back approximately 1800 kg of the fossil bearing rock, and since its arrival in Augustana College in March 1991, has been preparing and studying the specimen with Bill Hickerson from the National Science Foundation.

The dinosaur, more than half of which was found, has been named Cryolophosaurus ellioti or "frozen crested reptile". It most closely resembles Allosaurus, a bipedal dinosaur which is common in North America. The animal, about 9 m long, roamed Antarctica at the beginning of the Jurassic period some 200 million years ago.

The large curved crest was grooved, at least 25 cm high, and resembled an ornamental hair comb. However, the crest was probably not strong enough to use as a weapon but may have served as a means to attract the opposite sex. According to Dr Hammer the dinosaur was a meat-eater which means it was probably a loner rather than a pack animal.

Several other fossil fragments were found with the dinosaur, including part of a plant-eating dinosaur's foot; a part of a pterosaur; an isolated tooth of an animal related to modern mammals; and several teeth possibly from another meat-eating dinosaur.

Based on a report in **The Dispatch**, Moline, Illinois, 30 December 1992 (via **MAPS Digest**, March 1993) and a Reuter report from Washington, May 1994.

MELBOURNE'S SILURIAN ENVIRONMENT - THE TRILOBITE EVIDENCE

Andrew Sandford, Department of Invertebrate Palaeontology, Museum of Victoria, Melbourne.

A tiny piece of the jigsaw that makes up the geological history of Victoria came to light during the examination of the trilobites from the Melbourne - East Brunswick area, housed in the Museum of Victoria invertebrate fossil collections. Melbourne's bedrock is of Silurian age and is marine in origin, as testified by the many and various marine fossils recorded, including starfish, crinoids, nautiloids, gastropods, bivalves, trilobites, brachiopods and other extinct groups. The type of marine environment in the Melbourne area during this period has for decades been a matter for debate amongst local geologists. Was the ocean deep or shallow? How were the fossils and sediments deposited?

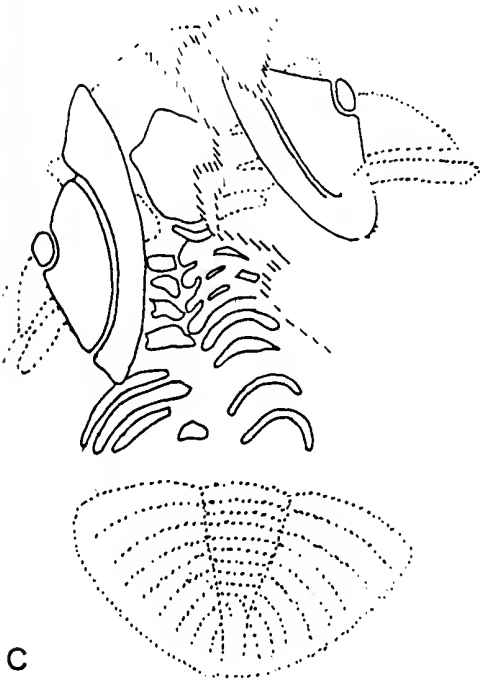
The deep sea theory.

Many geologists have interpreted the environment of deposition of this Silurian sequence as a deep basin or open ocean, disturbed only by submarine avalanches of mud (turbidity currents) from the continental shelf, carrying in sediments and dead animals which have since become the rocks (described as turbidites) and enclosed fossils. In this scenario, the only animals actually living in (or "autochthonous to") the deep sea Melbourne area were a few non-descript worms, all the other animals being considered as transportees (or "allochthonous"). The occasional sandstone beds in the Melbourne area are, in the deep sea scenario, presumed to be something like submarine rivers (channel deposits) carrying coarser sediment in a landscape of mud.

The shallow sea theory

Other geologists have interpreted the Melbourne area, as having been a shallow sea 410 million years ago, with all the fossil animals found in the rocks actually living in the area at that time (i.e., autochthonous), and deposition having been dominated by storm events rather than submarine avalanche events. Lithologically, storm sequences (tempestites) superficially resemble turbidite sequences. Up until now much depended on the interpretation of starfish and crinoids to resolve this dispute. Because echinoderms tend to break up into tiny pieces shortly after death, as soon as their body tissue rots, they cannot be transported whole and preserved as fossils post-mortem.

MELBOURNE'S SILURIAN ENVIRONMENT (Cont.)



A, Rhinotarion euryceps moult assemblage, with its free cheeks separated from the rest of the skeleton. B, Cromus spryi moult assemblage, with its free cheeks not visible, but rotated underneath. C, drawing (based on an actual specimen) of an unusually preserved moult assemblage, showing the free cheeks rotated underneath the trilobite.

Complete starfish and crinoid specimens commonly found in East Brunswick and the Melbourne area have been considered indicative of an autochthonous fauna and a shallower water environment, the animals preserved whole where they lived (rather than having been transported in). However, proponents of the deep water scenario consider that the starfish and crinoids could have been transported in the submarine avalanche as living victims, and thus preserved whole, though transported.

The trilobites figured here hold the key to the problem. These

trilobites, Cromus spryi and Rhinotarion euryceps are preserved as what are called "moult assemblages". Trilobites moult their exoskeleton as they grow, often shedding each group of segments in a particular sequence. R. euryceps flips off its free cheek (the side parts of the head shield) before it attempts to remove the rest, and can be seen here lying upside down next to the rest of the head. C. spryi rotates its free cheeks underneath the rest of the head before it pulls its head out of the exoskeleton. These moult assemblages prove that the trilobites, and the rest of the Silurian fauna, actually lived in the area. Moult assemblages cannot be transported intact, and it is not likely that a trilobite would live, let alone moult, after undergoing an avalanche into abyssmal depths. These tiny trilobites paint the big picture of a shallow sea in the area of Melbourne 410 million years ago.

WAS TYRANNOSAURUS REX REALLY TERRIBLE?

Alan Goldstein, (Naturalist), Falls of the Ohio State Park, 201, W. Riverside Drive, Clarksville, IN 47129, U.S.A.

John (Jack) Horner, the paleontologist at the Museum of the Rockies in Bozeman, Montana, presented a talk at Dino Fest in Indianapolis in late March. How late? Friday night at 10.30 p.m.! He started his presentation by stating that as it was so late, and everyone was so exhausted, no one would argue about his theory. (Jack was right).

Evidence of the predatory nature of Tyrannosaurus rex has been established as fact since its description by Osborne in 1905. Its six inch serrated teeth in a four foot jaw are legendary. But is that sufficient to prove that it could chase down and kill prey?

Jack Horner was not the first person to theorize that large bipedal carnivorous dinosaurs were scavengers. Lawrence Lambe speculated that Gorgosaurus (Albertasaurus) was a scavenger. Lambe thought it to be so slothful that it laid on the ground, only moving when very hungry (Norman, 1991).

Horner's evidence is pretty strong. Let's start with its legs. The fast-moving carnivorous dinosaurs like Deinonychus and Velociraptor have a slightly longer fibula (lower leg bone) than femur (upper leg bone). Tyrannosaurus' leg bones are closer to

WAS TYRANNOSAURUS REX REALLY TERRIBLE? (Cont.)

equi-length like ours. Humans are not fast runners in the animal kingdom.

The arms of the Tyrannosaurus are very small, to the point of being close to useless. Jack's vivid analogy was to imagine chasing and killing a chicken with your hands tied behind your back. You would likely die of exhaustion before capturing your prey! Other carnivorous dinosaurs, like those mentioned in the preceding paragraph, have longer arms with good gripping hands, enabling them to hold on to their prey. Remains of a Velociraptor was found in Bain Dzak, Mongolia, with a death grip on a Protoceratops, proving it at least used its hands to hold its prey. All living mammalian or avian predators can grip their prey with limbs.

The brain casts of Tyrannosaurus indicate a large olfactory centre. This is typical for scavengers which chiefly use the sense of smell to find food.

The eyes of T. rex are small. Many predators (birds and many mammals) have large eyes and acute vision. Those that do not (like dogs) are pack animals and hunt in groups. No evidence has been found to indicate a pack instinct for this dinosaur.

The large head and teeth of this beast may, in part, be an evolutionary result of the diminished use of arms. Strong jaw muscles and knife-like teeth would bight through tissue and bone with relative ease, since the arms could not be used to hold the food in place.

Paleontologist James Farlow presented a talk at Dino Fest on wear patterns of the teeth of Tyrannosaurus. While important tooth wear was shown to be evident (particularly on the inside of the mouth), the mechanism behind such wear is currently unknown. If tooth wear patterns can be understood, it might provide insight into how and what the "Tyrant Lizard King" actually ate.

Acknowledgements

I would like to thank my wife, Debbie, for proof reading the first draft and helping me remember what Jack Horner said, so late in the evening.

References

Norman, David, 1991. **Dinosaur!** Prentice Hall, 192 p.
Spalding, Davids A. E., 1993. **Dinosaur Hunters.** Prima Publishing, Rocklin, California, 310 p.

TERTIARY PTEROPODS

Ken Bell, Stony Creek, South Gippsland, Victoria.

This is another note on the smaller fossils to be found in the washings of the Victorian and South Australian Tertiary marls.

In the fine washings of many marine Tertiary marls in Victoria and South Australia occasionally small, planispiral, thin shelled gastropods are found which differ from the normal in being left-handed, that is, when viewed from above the shell whorls are formed anticlockwise. These small (<1-1.5 mm) gastropods are members of a larger group known as pteropods or sea butterflies. They are related to the opisthobranch gastropods and are a group of marine animals adapted to a wholly pelagic lifestyle.

There are three main groups of holoplanktic molluscs: the Heteropods (in the superfamily Atlantacea) which may have a large flanged shell or only a reduced small cap and have not apparently been found as fossils; the Pteropods belong to two groups - the Thecosomata and Gymnosomata - the Gymnosomata have a shell in the veliger stage but not in the adult, whilst the Thecosomata (sub-class Euthecosomata) have either a sinistrally coiled shell or a straight conical calcareous (aragonitic) shell, usually transparent and about 15 mm or less long. This suborder is the only one found as a fossil in Australia.

In living animals the large winglike foot is used for swimming and in some species as an aid in feeding; this foot is what gives them the colloguial name of sea butterflies. There are about three dozen living species recognised worldwide and their numbers in the present oceans are astronomical - it has been estimated that for one species alone (Limacina inflata) about 25 thousand million million individuals are alive at any one time (Wells 1979). Their distribution at present is markedly governed by temperature with the majority of species having a warm temperate to tropical distribution, only two or three species being found south of about 40°S in the colder waters. Such large numbers of specimens of pteropods creates the pteropod oozes found in many parts of the deep-sea basin sediments.

However, pteropods are not readily found as fossils - most likely because of the thin and fragile shell and to the fact that aragonite is more easily dissolved than calcite.

TERTIARY PTEROPODS (Cont.)

Not all pteropods have planispiral shells and the various shell forms make them fairly easy to identify to generic level (Fig.1).

There are only two families in the Thecosomata:

Family Limacinidae: these have a planispiral to trochoid shell; genus Limacina (also known in some classifications as Spiratella) - minute, to about 1.5 mm diameter.

Family Cavoliniidae: an uncoiled shell, which may be conical, pyramidal or nearly spherical: size up to about 15 mm long. Some genera in this family are:

Clio : laterally compressed, dorsally curved, with lateral carinae.

Styliola : conical, circular in section, transverse groove over dorsal side;

Creseis : long tapering, cylindrical;

Praehyalocylix : conical, slightly curved, transverse striations on shell;

Vaginella : vase-shaped, laterally compressed, may have lateral keels, an elliptical aperture.

Geologically the Limacinidae are known from the Eocene to Recent and the Cavoliniidae from the Upper Cretaceous. In Australia records are quite sparse. Only two papers have dealt with our Tertiary pteropods: Tate (1887) reported five species from Muddy Creek and Schnapper Point, Victoria, and Blanche Point, South Australia. More recently Janssen (1989) has recorded 18 species from Victoria and South Australia including in Victoria, Muddy Creek, Torquay, Shelford, Batesford and Fossil Beach, and in South Australia, Aldinga Bay. Over the same Tertiary time interval in the North Sea Basin more than 60 species are recognised. Janssen's number of specimens was small for most species and they were often broken and fragmentary. Figure 2 shows some of the Australian species (figures adapted from Janssen (1989). My own records (which are incidental to foraminiferan studies) show that although the pteropods are quite uncommon in washings, (a 100 g sample may produce about 5 pteropod shells), species are present from Upper Eocene (Brown's Creek, Vic.) right through the Tertiary. Little can be said about their stratigraphic ranges or usefulness as so little work has been done on them. What is needed is a concentrated effort to study these fossils; washing 10-20 kg of material from localities would surely bring to light many more specimens and species than is now known.

For anyone wanting more information on Recent south east Australian forms, Wells (1992) has an excellent key and diagrams, for fossil forms there are few works solely concerned with pteropods but a couple are listed in the references.

List of Australian Pteropods :

Limacina atypica
L. curryi
L. inflata
L. lunata
L. tatei
L. tertiaria
L. ? dilatata
L. sp. cf. L. gramensis
Creseis sp. cf. C.chierchiae
Praehyalocylix annulata
Styliola subula
S. sp.
? Clio sp.
Spoelia torquayensis
Vaginella bicarinata
V. depressa
V. victoriae
V. sp.

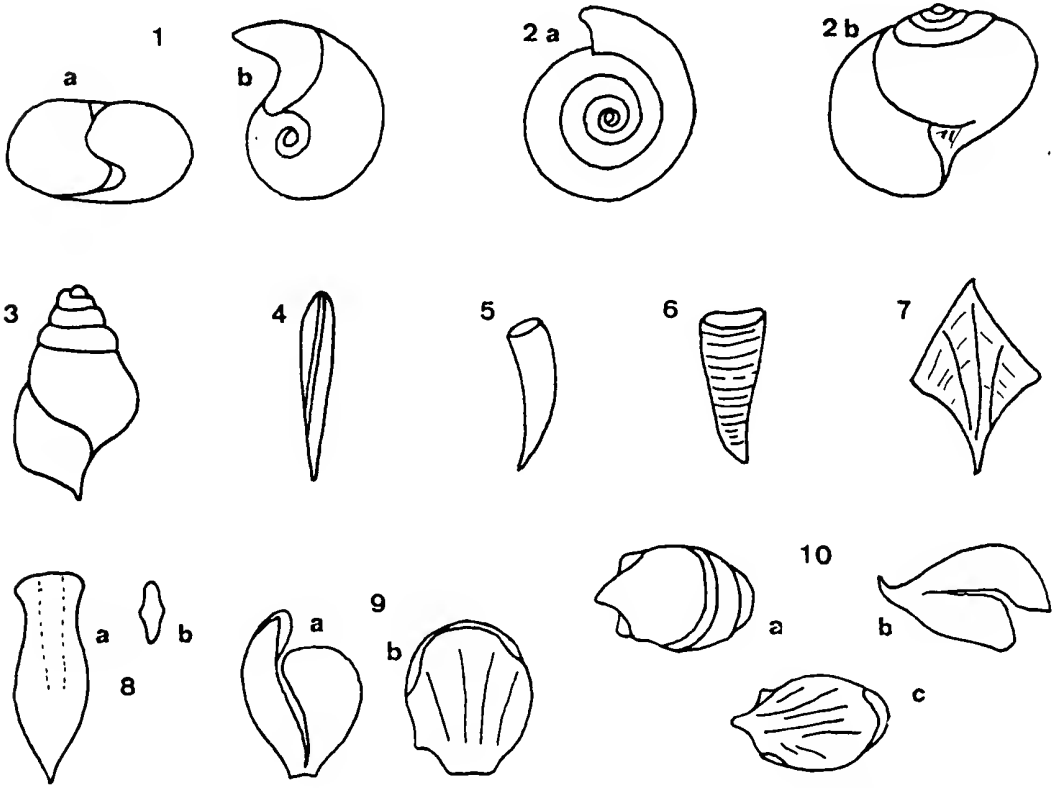


FIGURE 1. Guide to the various genera of Pteropods (various scales): 1, 2, 3, Limacina - various species; 4, Styliola; 5, Creseis; 6, Praehyalocylix; 7, Clio; 8, Vaginella; 9, Diacria; 10, Cavolina.

TERTIARY PTEROPODS (Cont.)

Notes on some of the species :

Vaginella depressa Daudin, 1800.

Janssen (1989) has placed Tate's V. eligmostoma in synonymy with V. depressa Daudin from the early Miocene of Bordeaux. This species is a stout, thick-set form and is present at Muddy Creek, (Muddy Creek Formation), Shelford and Balcombe Bay, Victoria.

Vaginella victoriae Janssen, 1989.

This differs from V. depressa in being more slender, by the strongly developed apertural folds which show a distinct downward divergence and that the dorsal labrum (lip) is lower than the ventral one. This form is only known from the Muddy Creek marl.

Limacina sp. cf. L. gramensis (Rasmussen, 1968).

This is a high-spired form of about 5 whorls in the adult. In Denmark (whence it was described) it is found only in the Late Miocene whereas in Victoria it is known from Early-Middle Miocene (Longfordian - Bairnsdalian).

Limacina inflata (d'Orbigny, 1836)

There seems to be no specific differences between this living form and shells found at Muddy Creek and other Victorian localities. Often specimens are totally complete and unbroken but their small size (<1.5 mm) makes them hard to detect.

Creseis sp. cf. C. chierchiae (Boas, 1886).

C. chierchiae is known from the late Quaternary and Recent faunas only, but at Batesford and Fossil Beach, Mornington, Victoria (Batesfordian-Balcombian ages), Janssen recorded specimens comparable with this species. The protoconch of this species has an elongated-triangular appearance and is sharply separated from the rest of the shell on the apertural side.

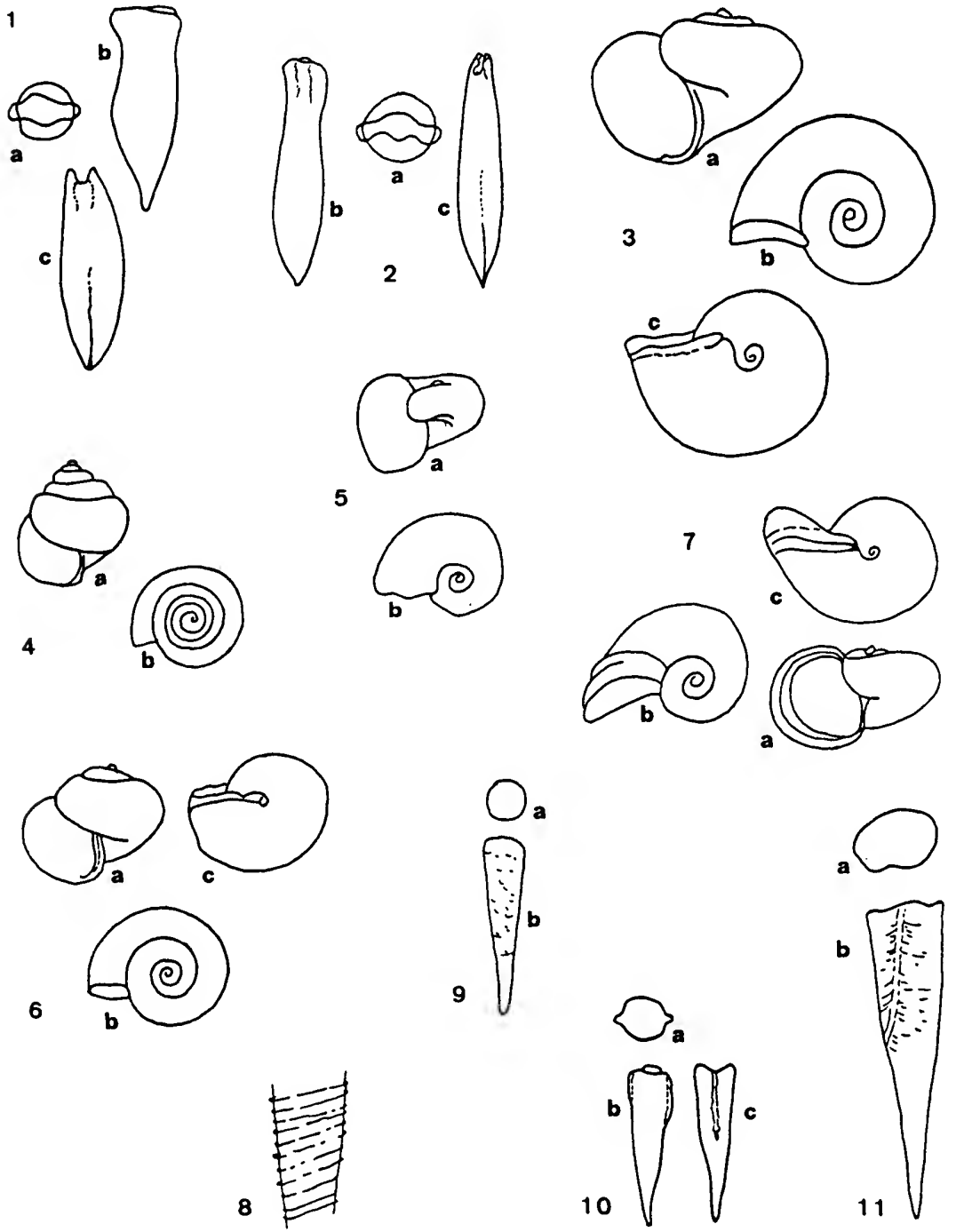
Spoelia torquayensis Janssen, 1989.

This genus and species is only known from the Late Oligocene at Torquay, Victoria (Jan Juk Formation) and from the Aquitane Basin in south-west France. Whilst similar to the genus Clio, it differs in the protoconch and in the adult form having two lateral squarish carinae which do not quite reach the aperture. There is also an extremely fine radial sculpture present.

Styliola subula (Quoy & Gaimard, 1827).

Tate's (1887) S. rangiana is considered a synonym of S. subula. This small, elongate, slightly curved shell is easily recognised

FIGURE 2 (right). Some Australian Tertiary Pteropods (figures after Janssen, 1989). 1, Vaginella depressa (x 4.5); 2, Vaginella victoriae (a, x 8.5; b,c, x 4.3); 3, Limacina curryi (x 20); 4, L. sp. cf. L. gramensis (x 20); 5, L. inflata (x 20); 6, L. lunata (x 20); 7, L. tertiaria (x 20); 8, Praehyalocylix annulata (x 4.5); 9, Creseis sp. cf. C. chierchiae (a, x 20; b, x 10); 10, Spoelia torquayensis (x 10); 11, Styliola subula (x 10).


1
a
b
c
2
a
b
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3
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b
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a
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6
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c
7
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b
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8
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a
b
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a
b

TERTIARY PTEROPODS (Cont.)

by the shallow longitudinal groove running obliquely across the shell from near the protoconch towards the aperture. It is widespread and found in most Batesfordian - Bairnsdalian sediments. It ranges up to about 7 mm long.

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THE FALLS OF THE OHIO STATE PARK: DEVONIAN PARK

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On January 25th, 1994, North America's newest fossil park opened to the public. The Falls of the Ohio State Park was the culmination of a preservation effort which took nearly five decades to reach fruition. Now a beautiful Interpretive Center sits above the Ohio River and the fossil beds. The falls are the only natural navigational obstacle over the river's 1635 km (981 mile length.

The fossil beds, generally considered to be Middle Devonian, actually straddle the Lower/Middle Devonian (Emsian/Eifelian) boundary. The fossils have been the subject of both scientific study and general curiosity for more than two centuries. Fossils with labels reading "Falls of the Ohio, Louisville, Kentucky" adorn museum collections world wide. In an effort to preserve the remaining fossil beds, collection is prohibited without a permit, such permits only being provided for bonafide research. However, there are numerous quarries and road cuts where fossils may be collected in the Louisville area.

The name "Falls of the Ohio" is actually a misnomer. There was never a water fall in the strictest sense. The "falls" were actually a series of rapids and small falls in which the river dropped some eight meters (26 feet) over a distance of four kilometers (2.5 miles). The largest water fall was less than 5 meters (about 15 feet).

FIGURE 1. The Falls of the Ohio State Park Interpretive Center, designed by Architects Wolpert and Associates of Dayton, Ohio.

THE FALLS OF THE OHIO STATE PARK (Cont.)

As a result of the falls, the cities of Louisville, Kentucky and Jeffersonville, Clarksville and New Albany, Indiana, were established. They are collectively called the "river cities". The largest inland boat building facility in the United States is located about 1.6 km (1 mile) above the falls.

The falls were virtually unnavigable during the dry summer and autumn months and dangerous during the winter and spring. The Portland Canal was dug diagonally across a sharp bend in the river, to allow boats to bypass the falls. This was enlarged several times during the 19th century, and locks were installed. The U.S. Army Corp of Engineers built the McAlpine dam and enlarged the locks in 1964. More tonnages of goods pass through these locks annually than through the Panama Canal. The dam is peculiar in that it is "Z" shaped, with "upper" and "lower" tainter gates. While it seems that the dam was designed to preserve the fossil beds, that is not so. The shape funnels more water to the "lower gates" where a hydroelectric power plant was installed. The river is exceptionally wide at the falls and the section of dam that runs parallel with the river maintains a channel with sufficient water volume to run the turbines.

The first bridge to cross the Ohio River, erected in 1870, was built at the falls. Although modified somewhat, it is still used today. The large limestone blocks incorporated into the bridge piers were quarried in Louisville. Examination of them today reveals a plethora of cross-sections of Middle Silurian corals and stromatoporoids.

The fossil beds are primarily the Jeffersonville Limestone, named for exposures along the Ohio River that are now submerged by the dam. Under exceptionally dry conditions (about once every two years) the Middle Silurian (Wenlockian) Louisville Limestone is exposed (characterized by an abundance of Halysites and Quepora chain corals).

The Jeffersonville Limestone has been subdivided by paleontologists into five faunal zones. The lowest is the coral zone, for which the fossil beds have gained the greatest fame. The age of the lower coral zone is Emsian (Lower Devonian) and the upper coral zone Eifelian (Middle Devonian). There is no unconformity along the boundary.

The coral zone makes up the largest part of the fossil beds and

is under water most of the year. The best time to visit and expect to see the fossil beds (which are over 150 acres) is late August - early November. They are designated as the "inner" and "outer" fossil beds. The former are within the Indiana state boundary, the outer beds in Kentucky.

Above the coral zone is the Amphipora ramosa zone, named for this spaghetti-like stromatoporoid. It forms small cliffs on the edge of the Indiana shore line, and occurs as cliffs and "flats" on the "outer" beds.

The Brevispirifer gregarius zone forms the next layer. It has a distinctive silicified zone which is a stratigraphic marker in the area. Limestone leaches out by ground water leaving fossiliferous rocks with a remarkable light weight per unit of volume. Many fossil casts of molluscs are coated with drusy quartz, while the remaining fossils sparkle under the sunlight. Surface detail can be exquisite! The silicified zone weathers a distinctive orange colour, and occurs above the cliffs and on the "outer" fossil beds. The limestone layer was enriched with silica from a volcanic eruption during the Middle Devonian. This layer is represented by a metabentonite layer several centimeters thick in the State of New York.

The bryozoan - brachiopod zone is above the Brevispirifer zone and is so named because of the abundance of these fossils. Large fenestrate bryozoans may be found, as are many other fossil phyla.

The uppermost faunal zone is the Paraspirifer acuminatus zone. Actually, this species occurs in the units above the Amphipora zone, but does not become abundant until this layer. It is also characterized by a large faunal diversity. At road cuts in the Louisville area, it is possible to collect molluscs, brachiopods, bryozoans, blastoids, trilobites, graptolites, ostracods, corals and other fossils.

Glacial outwash deposits form a "beach" of sand and rounded pebbles. There are some erratic boulders, the largest weighs in at several tons. Stringers of magnetite/garnet sand may be found with the normal brown river sand. At the mouth of Silver Creek (where it enters the Ohio River), late Pleistocene lake deposits occur, with an abundance of fossil leaves. The property was not acquired for the State Park because it is immediately adjacent to several hazardous waste dumps! A sand and gravel pit on Silver Creek just north of the park has been a source of

THE FALLS OF THE OHIO STATE PARK (Cont.)

A

B

C

D

FIGURE 2. A. Diorama of a patch reef (Lobby) showing Siphonophrentis - large horn corals (top left); Herclocerus - cephalopod (center right); Pleuronotus - gastropod (bottom left); Heliophyllum - rugose coral (bottom center); and Turbonopsis - gastropod (bottom right) resting on Emmonsia - large tabulate coral.

B, The Devonian arthrodire fish Dunkleosteus swimming above a bioherm containing Siphonophrentis, Prismatophyllum and Emmonsia (Lobby exhibit).

C, Fibre glass cast of a large Columbian mammoth skeleton in the center of the Lobby.

D, The Middle Silurian (Wenlockian) section of the diorama, representing the Louisville Limestone, showing a cephalopod swimming above Halysites - tabulate coral (center left); Caryocrinites kentuckiensis - cystoid (top right); Coenites reticulata (bottom left) and Favosites (center right) - tabulate corals; Pentamerus - brachiopods (bottom center); and Entelophyllum - rugose coral (center).

giant mammoth remains. Consequently, the Interpretive Centre lobby is dominated by a fibre glass cast of a similar creature (the local site did not produce a complete skeleton).

The Interpretive Center was designed by Wolpert and Associates, an architectural firm in Dayton, Ohio. This was their first museum-type building. The Center's architectural statement is stratification. Both inside and outside, Indiana limestone and various earth-tone bricks create the layered look.

Exhibits relate to the park's theme: geology, natural science, local history and river industry/technology. They were designed, fabricated and installed by the world-renowned Chase Studios from Cedar Creek, Missouri. At a cost of $400 (US) per square foot, the exhibitry is like fine art, with meticulous detail. A total of nearly $900,000 (US) was spent on the exhibit gallery.

Visitors will see the impressive lobby exhibit containing a large Columbian mammoth skeleton (fibre glass cast) and a giant mural with a "bird's-eye" view of the falls before European settlement. This exhibit contains snippets of other displays covered in more detail elsewhere in the Interpretive Center exhibit hall. Beneath the mammoth is a reconstruction of the Devonian arthrodire fish Dunkleosteus and above it the replica of a restored Devonian shark Cladoselache. A variety of taxodermied birds and fish hang from the rotunda ceiling. Below the head of the mammoth is a recreation of the Middle Devonian coral beds, both as living and as now preserved at the Falls of the Ohio River.

One major fossil exhibit includes a diorama painstakingly detailed to show life in the Middle Silurian Louisville Limestone sea, and the Middle Devonian seas of the Jeffersonville and North Vernon Limestones. Models were created for over 200 species of fossils to bring this diorama to life!

Next, visitors will view a cast of a life size Dunkleosteus skull in an under sea setting with a Callixylon log floating above complete with dangling Melocrinus. This exhibit relates to the formation of the New Albany Shale, a Middle to Upper Devonian black shale that occurs across the mid west (it is also called the Ohio and Chattanooga Shales). Adjacent to that display is a diorama which recreates the source of the New Albany Shale flora. Callixylon/Archaeopteris trees were among the world's first large (10+ meter) trees, with trunk diameters up to 1.7 meters. Ancestors of the horsetail (scouring rush) called Pseudobornia

THE FALLS OF THE OHIO STATE PARK (Cont.)

reached nearly 25 meters. The forest ringed by stagnant New Albany Shale-producing sea.

Additional exhibits include the Pleistocene geology and how glaciation helped create the Ohio River, local topography and its significance, prehistorical native cultures, natural history, how the falls influenced the development of local communities, river boats, industry and technology.

In addition to exhibits, the Center contains a 13½ minute orientation theater production on the history at the Falls. Some of the most unusual footage was shot with Devonian models on a reef near San Salvador. Nowhere else can you see a living trilobite crawl across the sea floor! (Okay, so it is a Limulus dressed as a Coronura!). This film is a must see for visitors!

The Interpretive Center contains a wildlife observation room and river observation room, where one might glimpse some of the 265 species of birds reported at the Falls. A library/resource room has been established for visitors and researchers needing access to books and other materials in our possession. We are seeking additional publications and materials relevant to Silurian and Devonian stratigraphy and paleontology on a world wide basis. Eventually, we may seek to exchange fossils with geologists and museums to diversify our paleontological collections.

A small gift shop contains a variety of publications, geological specimens, and crafts items. Of particular interest to fossil collectors is a new publication by the Kentucky Geological Survey "Fossil Beds of the Falls of the Ohio", which can be purchased from the Park at $8.50 (US) + $5 for air mail or $2 surface mail postage. This 40 page book covers geology, a walking tour, and information/illustrations about the fossils seen at the Falls. It is probably the best book written to date for people with an interest in these fossils.

The naturalist staff will provide tours of the fossil beds to the public (as the river level permits) from May 1st - Oct. 31st. School groups will be offered hands-on labs from Nov. 1st - Apr. 30th. Teacher training programs in paleontology and other topics will be offered annually. The park is open 9 a.m. to 5 p.m. all year round. Admission is $2 (US), $1 for children 12 and younger.

More information can be obtained by contacting the writer.

IN THE NEWS (CONT.)

CETACEAN MISSING LINKS

In mid 1990 (Science, vol. 249), paleontologists from the University of Michigan and Duke University, North Carolina, reported that skeletons of an ancient whale with rudimentary legs had been discovered in the desert of Zeuglodon Valley in north-central Egypt. Named Basiliosaurus, this 40 million year old Archaeoceti (ancient whale), from the Eocene epoch represents a transitional stage of development between a land mammal that walked on its hind limbs and the modern legless whale.

Basiliosaurus was about 16 metres long and had vestigial legs, tiny and perfectly formed. Although the animal could move these hind limbs a little, rotating them down and outward from a suggested resting position, they would have been all but useless for swimming and, considering the large size of the animal, could not have supported its weight out of water.

Now a team of paleontologists from the USA and Pakistan have discovered a nearly complete 50 million year old fossil whale. Named Ambulocetus natans (the walking whale), it had short stocky hind legs and large feet which would have enabled it to move on land.

The fossil, found in the Kala Chitta Hills of Pakistan, is composed of skull, teeth, vertebrae and limbs, including hands and feet, and was about the size of the largest male sea lions, weighing 300 to 350 kilograms and measuring about three metres from snout to tail.

According to the team leader, Dr Hans Thewissen of Northeastern Ohio Universities College of Medicine, the thigh and shin bones of Ambulocetus were much longer than those of a sea lion but short compared with land animals. As its front feet pointed outwards, it would have made walking awkward, consequently, when on land it probably rested its body on the ground. Thewissen thinks the animal hunted at sea, moving its backbone up and down and using its webbed feet to propel it through the water.

This latest discovery hints at Pakistan as the centre of origin for whales, as Pakicetus, the oldest whale so far recorded (52 Ma) and known only from teeth and parts of its skull, was also found in the same region.

According to Professor Michael Bryden, an Australian expert on whales from the Department of Veterinary Anatomy at the University of Sydney, there will be more and more such discoveries, as there are still a lot of missing pieces in the evolutionary chain between a land-bound wolf-like animal with hooves, such as Mesonychids, and an animal that lives entirely in the sea.

Based on reports in **New Scientist**, 21 July 1990 & 22 January 1994; and article by James Woodford and agencies, **Sydney Morning Herald**, 15 January 1994.

ISLAND CAVE YIELDS TREASURE OF FOSSILS

A scientist from the WA Museum has found a cave on Barrow Island, about 135 km west of Dampier in the north-west of Western Australia, which is littered with the fossilised remains of animals that roamed Australia four million years ago.

Palaeontologist Dr Ken Aplin believes the remains may provide a missing link for scientists tracing the ancestry of animals on mainland Australia and yield important information on the evolution of marsupials. Various teams of Australian and US scientists have searched for more than 30 years for traces of animals bridging the

ISLAND CAVE YIELDS TREASURE OF FOSSILS (Cont.)

gap between modern groups and their more primitive, forest-dwelling ancestors of 10 million years ago.

The marsupial fossils, which included types of ringtailed possums and several different kangaroos, were found in firmly packed cave earth that was exposed in a cave on the side of a barren limestone hill. The present landscape is a far cry from the Early Pliocene environment in which the animals lived - a critical period in Australia's history when the ancient forests that covered much of the continent gradually gave way to arid land. The several species of kangaroo had high-crowned cheek teeth similar to animals living today in forests and grasslands.

Dr Aplin plans to take a big expedition to the island in July and August.

Based on a report by Brendan Nicholson in the **West Australian**, 24 February, 1994.

BOOKS AND BOOK REVIEWS

TRIASSIC BRYOZOA FROM THE MURIHIKU AND TORLESSE SUPERGROUPS, NEW ZEALAND by Prisca Schafer and Jack Grant-Mackie. Association of Australasian Palaeontologists Memoir 16, 52p. (1994).
Price AUS$ 20.00 (within Australia).

Describes and figures 19 taxa including 2 new genera and 4 new species of stenolaemate bryozoa from the Middle and Upper Triassic. The fauna contains both endemic and Tethyan elements and either belong or are closely related to Palaeozoic trepostome families or genera.

Available from Dr P. A. Jell, C/o. Queensland Museum, P.O. Box 3300, South Brisbane, Queensland 4101.

THE GEOLOGY OF SOUTH AUSTRALIA (Volume 1 - The Precambrian) edited by J. F. Drexel, W. V. Preiss and A. J. Parker. South Australian Department of Mines and Energy Bulletin 54, 242p. (1994).
Price AUS$75.00 plus p & p of $8.00 Aust., $20.00 Overseas surface.

Available from the Dept. of Mines & Energy, South Australia, P.O. Box 151, Eastwood, S.A. 5063.

PALAEOZOIC VERTEBRATE BIOSTRATIGRAPHY AND BIOGEOGRAPHY edited by J. A. Long. Bellhaven Press, 25 Floral St., London WC2E 9DS, UK, 370p. (1993). List price STG65.00 (hard cover).

An important book for anyone interested in Palaeozoic palaeobiogeography, fossil fish or Palaeozoic continental reconstructions. For a comprehensive review by John A. Talent, refer The Australian Geologist, Newsletter 89, December 20, 1993.

EVOLUTIONARY PATTERNS AND PROCESSES edited by D. R. Lees and D. Edwards. Academic Press, 24-28 Oval Road, London NW1 7DX, UK, 320p. (1993). List price STG45.00.

Based on a symposium of the Linnean Society, London, discusses the diversity in current evolutionary research.