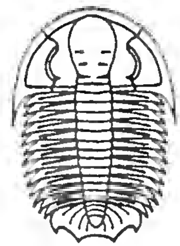
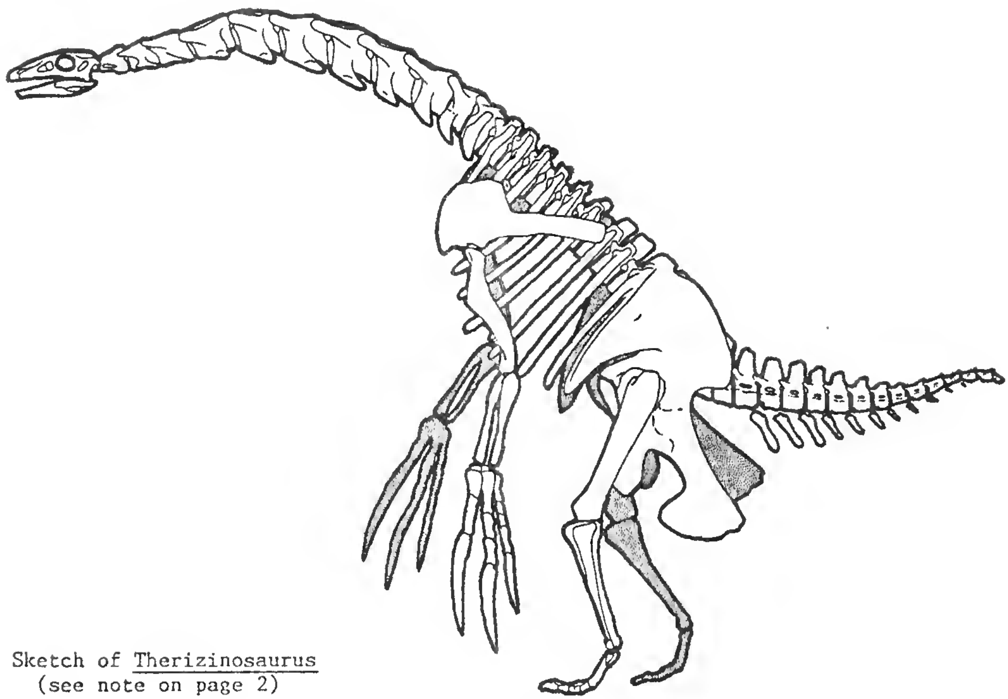
THE FOSSIL COLLECTOR



BULLETIN Nº 41 SEPTEMBER 1993



Sketch of Therizinosaurus
(see note on page 2)

Published by
THE FOSSIL COLLECTORS ASSOCIATION OF AUSTRALASIA
ISSN 1037-2997

FOSSIL COLLECTOR'S ASSOCIATION OF AUSTRALASIA

SECRETARY

F. C. Holmes, 15 Kenbry Road, Heathmont, Victoria, 3135. (03) 7290447

REPRESENTATIVES

AUSTRALIAN CAPITAL TERRITORY

Mrs. M. Webb, Fairlight Stn., R.M.B. 141, Weston, 2611. (062) 365123

NEW SOUTH WALES

Eric Nowak, 29 Bungalow Rd., Roselands, 2196. (02) 7581728

QUEENSLAND

Ian Sobbe, M/S 422, Clifton, 4361. (076) 973372

SOUTH AUSTRALIA

John Barrie, 1 George Terrace, Coonalpyn, 5265. (085) 711172

TASMANIA

John Fennell, R.S.D. 533, Allport St., Leith, 7315. (004) 282543

VICTORIA

Frank Holmes, 15 Kenbry Rd., Heathmont, 3135. (03) 7290447

WESTERN AUSTRALIA

Mrs. L. Schekkerman, 11 Marian St., Innaloo, 6018. (09) 4463583

CONTENTS

FRONT COVER: Sketch of Therizinosaurus, a Late Cretaceous theropod dinosar from the Nemegt Formation, Gobi Desert, southern Peoples' Republic of Mongolia (modified from National Geographic Exploration and Research) with acknowledgements to the Qantas Great Russian Dinosaurs Exhibition 1993-1995.

EDITORIAL

As'Dinomania' sweeps Australia with the release of Stephen Speilberg's film "Jurassic Park", it is disturbing to read (Archbold, p.10 - this issue) that in Australia, traditional geology departments are continually downgrading the role of palaeontology among their disciplines. Indeed the current issue of the Palaeontology Association Newsletter (No.19, Summer, 1993) also reports concern about the lack of any palaeontological presence in the centre of British geology.

With the current publicity given to palaeontology (even if it is predominately dinosaur related) that we are witnessing in the popular press; in lengthy articles in magazines such as Time (9th August), Australian Natural History (Spring, 1993), Scientific American (July, 1993), Earth (September, 1993) etc.; numerous television news and current affairs programmes and the four part American produced dinosaur series recently screened on ABC TV; the issue of Australia's first series of stamps depicting fossils; and the Qantas Great Russian Dinosaurs Exhibition; we are surely creating even more problems for the future. When the youngsters of today who sustain their enthusiasm for palaeontology and eventually manage to obtain a related Tertiary qualification, they will almost certainly have little if any chance of finding employment in this field, irrespective of the level of national unemployment at the time.

Together with the upsurge in interest in dinosaurs comes the rapid increase in demand for, and consequently market value of, display quality fossils - notice how dinosaur eggs have miraculously appeared on the world market in large numbers! Unfortunately all this activity and overseas demand, particularly in Germany, Japan and the USA seems to have created an unrealistic idea of the value of many fossils on the Australian market, particularly among non-collectors. To think that someone in Australia was supposedly prepared to pay $150,000 or more for the *Aepyornis* (?) egg recently discovered in W.A., leaves me flabbergasted (did anyone see an authenticated written offer with a priviso that it would not be sent overseas - legally or illegally?).

On a much more pleasant note, as we go to press, I have received a paper describing a new genus of marsupiate echinoid, the holotype and one paratype of which were found and donated to the South Australian Museum by our S.A. representative, John Barrie (ref. McNamara K.J. and Barrie, D.J., 1993. A new genus of marsupiate spatangoid echinoid from the Miocene of South Australia. *Rec. S. Aust. Mus.* 26(2): 139-147).

Macquarie University will be hosting an **Australian Palaeontological Convention** from 7-9 February, 1994. For further information contact Glenn Brock, Centre for Ecostratigraphy & Palaeobiology, Earth Sciences, Macquarie University, Sydney, N.S.W. 2109 [phone (02) 8057484; fax (02) 8058428].

DEADLINE FOR THE NEXT ISSUE

Material for the next issue should be submitted by 20th. December, 1993, unless otherwise arranged with the Editor. **Articles and extracts etc. urgently needed.**

Frank Holmes

FINANCES

Statement of finances as at 15th September, 1993:

Carried forward from previous year	$ 2111.86
Add income 1.3.1993 to 15.9.1993	$ 1136.63
	$ 3248.49
Less expenditure 1.3.1993 to 15.9.1993	$ 1052.48
	$ 2196.01
Deduct advance subscriptions for 1994/95	$ 68.00
Balance in hand (excluding cost of this Bulletin)	$ 2128.01

REVOLUTIONS IN PALAEONTOLOGY

Neil W. Archbold, Deakin University, Rusden Campus, Clayton, Victoria.

The following article is based on part of a lecture given to the Geological Society of Australia (Victorian Division), 24th June, 1993.

Introduction

The first part of the presentation earmarks the development of palaeontology in terms of revolutions of thought - where have the big steps been in the past and what of the future of the subject. Information is drawn from that provided by J. C. Thackray. P. J. Bowler, J. W. Valentine and A. Hoffman, in Chapter 6.5, 'History of Palaeontology' in the text edited by D. E. G. Briggs and P. R. Crowther (1990) and the classic work of Karl Alfred von Zittel (1901).

Revolution 1. The organic origin of fossils

The first major revolution in palaeontology was the recognition that fossils were of organic origin. Niels Stensen (1638-1686), who studied a modern shark jaw and the fossil sharks teeth from Malta had by 1667 no doubts on the matter, but the organic origin was not obvious to all. The debate lasted about 50 years from 1660. It may seem to be a bizarre debate to the modern fossil collector and palaeontologist but a debate it was! One of the key workers to close the debate was Johann Scheuchzer (1672-1733) who, in 1708 published a work on fossil fish with meticulously prepared illustrations. He considered that fossils were clearly the remains of past life and bore witness to the biblical flood. The important thing is of course that by the time we arrive at Linnaeus (1707-1788), that gentleman who decided to classify everything from God to the humblest living creature in his Systema Natura (first edition, 1735), it was accepted that fossils were part of the biological realm and therefore had to be classified accordingly. About this time an increasing realisation that the Earth was much older than a few thousand years was also taking place, an idea that was important in the second revolution.

Revolution 2. The problem of extinction

The second revolution was the problem of extinction. There were great rumblings during the 1700's when people debated, using of course the only 'scientific' text available - the Bible, as to whether organisms could possibly be extinct. This problem of extinction was accidentally solved by Georges Cuvier (1769-1832) who studied vertebrate animals, in particular the elephant group. Having access to both African and Indian elephant skeletons as well as Mammoth and Mastodon skeletons he was able to determine that not only were the two living elephants different (two species) but that the Mammoth and Mastodon were clearly extinct types of elephants. He then came up with the idea of what he called the 'Revolution of the Globe'. Your real catastrophe theory, with mass flooding over much of the world causing organisms to go extinct and subsequently to be replaced by new populations.

Cuvier did not rely on supernatural intervention in order to explain extinction, however, contemporary British palaeontologists such as Robert Jameson (1774-1854) and William Buckland (1784-1856) seized on Cuvier's work and introduced the 'hand of God' thus tainting the idea of Catastrophism - a point strongly argued against by the geologist, Sir Charles Lyell. Catastrophism has crept back into modern geology - e.g., the concept of an event such as a meteorite/asteroid impact. However, such an event is a normal geological event as defined by James Hutton in his Uniformitarianism wherein he was very particular to point out that not all processes work at the same rate now as in the past. In terms of impact events we know, of course, that they are now widely spaced in time - unlike 4,000 million years ago!

Revolution 3. The rise of biostratigraphy

The third revolution in palaeontology was the development of biostratigraphy - something which is useful rather than theoretical. The leaders in the development of biostratigraphy were William Smith (1767-1839), who discovered that strata were characterised by the animal and plant fossils imbedded in them and published the first geological maps of Great Britain; Georges Cuvier who with Alexandre Brongniart (1770-1847) studied the rocks of the Paris Basin and produced stratigraphical works on the Cretaceous and Tertiary of France; and Ernst von Schlottheim (1764-1832) who documented Carboniferous floras of the coal measure sequences of Germany in 1804.

The culmination of biostratigraphy was of course the Geological Time Scale. This came about by the synthesis of people like Sedgwick, Murchison and Lyell, primarily between 1830 and 1841, although the Ordovician was added a little later and even today we are still in the process of subdividing and improving the detail. In 1841 the proposal for the establishment of the Palaeo-

REVOLUTIONS IN PALAEONTOLOGY (Cont.)

zoic, Mesozoic and Cainozoic divided the periods into eras and the Time Scale was 'born'. It is important to note that the Time Scale was set down in a period of just over 10 years - almost 20 years before Darwin published his "Origin of Species".

The men who established the time scale were, of course, impressed with the order of the fossil record and the capacity to use the record for international correlation. Forms of life appeared and disappeared within the fossil record never to appear again. Today the world's largest industry (oil and gas exploration) utilises the power of biostratigraphy. Why? Quite simple! It works.

Revolution 4. The acceptance of evolution.

The fourth revolution is evolution itself. Through Darwin and his writings, although we should not forget that Darwin largely dismissed the fossil record, - to him it was not particularly useful, and through the development of Mendelian genetics, logical explanations of the 'progression' of the fossil record were provided.

During the 1940's and 1950's evolutionary theory started looking at adaptive scenarios - organisms adapting to their environment, what are the mechanisms of adaptation, and micro evolution within populations of organisms, etc. Clearly palaeontology had to face up to evolution thus causing a revolution in thinking about, and how to explain, the fossil record.

Revolution 5. The advent of palaeogeography.

The fifth revolution can be termed 'The Revolution of Palaeogeography' - when people started looking at the distribution of fossils around the globe. Ideas such as continental drift started to trigger arguments back in the 1920's. Continental drift was of course largely dismissed, particularly in the northern hemisphere - at that time you didn't need it to explain the geology of North America or the Eurasian land mass. It is very interesting to go back and look at some old literature and see the definitive statements that were made against continental drift.

'Trouble makers' in the southern continents who advocated drift or movement, used the fossil record of the Permian plant Glossopteris and the marine bivalve Eurydesma with its associated fauna, to substantiate their claims. However, that fossil record was not absorbed and understood in the northern hemisphere's centres of learning. It was frequently simply not referred to.

1960-1975 witnessed the rise of plate tectonics. Past reconstructions of continents became common place although data was frequently lacking or ignored for regions like Asia. However, concepts of the face of the globe through geological time had been changed forever.

Revolution 6. The influence of the biological sciences

A great revolution within the biological sciences was that of ecology, an area of thought that increased in importance during the 1960's. This impacted on palaeontology through the field of palaeoecology, an ongoing area of investigation.

It is of interest that palaeoecology was a significant area of research in Soviet palaeontology as far back as the 1940's.

Revolution 7. The early history of life

Another revolution relates to the early history of life. In the 1960's the so called microbiotas of the Proterozoic rocks, even going back to the Archean rocks with their stromatolites, were being investigated. Mistakes were made and errors were introduced, but that work accumulated; no longer did palaeontology stop at the Cambrian. Here was a revolution that was opening up the history of life - something of no small importance. This was coupled with the increase in study of the Ediacara faunas, although the South Australian one was well known, (having been discovered in 1946 by Reginald Sprigg) it was often dismissed as a problem - was it just an unusual Cambrian environment? However, these faunas cropped up elsewhere in the Soviet Union and so on, and have now given rise to the Ediacara and Varanger Epochs of the Vendian Period in the Geological Time Scale (Fedonkin, 1987).

The recollecting and re-evaluation of the Burgess Shale and other Cambrian strata showing that there were huge numbers of organisms unrelated, perhaps even at the Phylum level, to organisms living today. So the whole issue of the evolution and radiation of life was opened up and no longer was palaeontology just a biostratigraphical tool, it became a question of the evolution of the history of life. The question of course is <u>not</u> of burning concern to many geologists but is of interest to a range of scientists, philosophers, etc.

Revolution 8. Developments within evolutionary theory

REVOLUTIONS IN PALAEONTOLOGY (Cont.)

The final revolution in the 1960's and 70's, one which is still going on, is evolutionary theory itself. Palaeontologists started feeding back information, for surely the fossil record had something to say about evolution. It had been pushed to one side, it had been dismissed by Darwin, it had been shoved away because the record was considered to be too incomplete. But was the record incomplete, perhaps in fact the record was incredibly complete. And so you get the dismissal of phyletic gradualism (incremental little changes in species through time) and the rise of punctuated equilibria (periods of rapid evolution interspersed with periods of stasis). This explained why it was invariably easy to pick out biostratigraphical horizons in sedimentary sequences.

Consequently you now had the knowledge, flowing through to sedimentary studies, that if you have a sedimentary sequence it does not represent continual slow sedimentation, it represents episodes or bursts of activity, triggered by transgressive or other events.

During the 1980's the scope of palaeontology opened up to quite literally cover the history of the earth - the history of the biosphere and the interaction of the biosphere with the planet. Within modern palaeontology it is possible to talk about two approaches: one is termed palaeontography, and the other theoretical palaeobiology - now we have a divergence of approach.

Palaeontography includes items such as the description of fossils; reconstruction of fossil organisms - what did they look like in their habitat; classification (phylogeny) - phylum, class, order etc., right down to genus and species; biostratigraphy, which as a subject and as a tool is a vital part within the geological sciences; palaeoecology - linked in with sedimentary geology, past environments of deposition etc.; and palaeobiogeography - reconstructing the past distribution of continents.

The important thing is that in all of these, Theory is not a goal in itself. We are not after the origin of the universe by doing palaeontography, we are not even after the origin of life but the theoretical palaeobiology, which is the revolution of the last ten years, includes such things as evolutionary theory; ongoing ideas about punctuated equilibrium; species selection (evolution at the species level); and taxonomic diversification through time, the actual biological world - has it expanded or has it increased through time - what has happened to it? The spin off from this is information about global changes through time, again an area of interest to geologists.

Mass extinctions engender a vast amount of discussion in the literature as to how, why and when. The large quantity of empirical data on palaeontology, microstratigraphy, sedimentology, geochemistry, mineralogy and so on, that has been accumulated by studying these events is immensely important as a feedback into geological studies, although it is primarily separate from traditional geology. This theoretical palaeobiology, as the texts call it, is not separate from the earth sciences, it is very much a part of the earth sciences. It is concerned with questions such as the development of new biological laws for understanding the biosphere. I suggest that the way palaeontology is going, it is now no longer a biostratigraphical handmaiden of geology, it is a full subject in its own right - **'The History of Life on Earth'.**

One of the books I read recently said that palaeontology was both fascinating and fashionable. We know of course that elements of palaeontology are fascinating to the general public - put on a dinosaur display and you soon find out about that - but 'fashionable'? How fashionable is it? Count up the geoscience departments in Australia and see how many Professors of Palaeontology in senior positions have retired in the last 15 years and see how many have been replaced by even a junior lecturer. Geologists who have any interest in biostratigraphy as a tool had better look out, because in 15 years' time there might not be anyone trained in biostratigraphy.

Theoretical palaeobiology, the big arm waving parts, the theoretical parts, sure they are fascinating and in fact they are fashionable, but not in Geology Departments. Palaeontologists are primarily historians of the biosphere and hence reconstruct history. They document and conduct research on unique historical biological events and sequences of events. Models are developed and if possible quantitatively tested. To this end a detailed stratigraphical framework and taxonomic system are critical. Basically, I maintain you can not have a palaeontologist if that person has not been trained in taxonomy. However, I do not believe that all undergraduate geology students should be trained in taxonomy, but it has got to be done somewhere and obviously stratigraphy must also be studied.

REVOLUTIONS IN PALAEONTOLOGY (Cont.)

The view of the biosphere as part of the global system incorporating life, ocean, air and lithosphere, has lead palaeontologists to collaborate with people with interests in stable isotope geochemistry, palaeoceanography, palaeoclimatology and so on. More and more palaeontologists are getting involved with other specialties and some of these specialties are outside geology.

Palaeontology provides a key to time and the unique documentation of the evolution of life on earth. As a discipline it straddles the life and earth sciences but it is not yet clear in this country where future palaeontologists will be trained as traditional geology departments downgrade the role of palaeontology among their disciplines.

References

Briggs, D. E. G. and Crowther, P. R. (eds.), 1990. **Palaeobiology a synthesis.** Blackwell Scientific Publications, 583pp.

Fedonkin, M. A., 1987. Besskeletnaya fauna venda i ee mesto v evolyutsii Metazoa (the non-skeletal fauna of the Vendian and its place in the evolution of metazoans). **Trudy Paleontologicheskogo Instituta, Akademiya Nauk SSSR.** Tom 226: 1-176.

von Zittel, K. A., 1901. **History of Geology and Palaeontology.** Translated by Maria M. Ogilvie-Gordon. London, Walter Scott, i-xvii, 562pp.

FOSSIL CHELICERATES OF AUSTRALIA

Paul Selden, University of Manchester, Manchester, M13 9PL, U.K.

Abstract: The fossil chelicerates, and similar forms, of Australia are reviewed. The fauna comprises two aglaspidids (Cambrian, Tas.), five xiphosurans (Devonian, NSW; Permian, Tas; Triassic, NSW; Cretaceous, Vic.), two named eurypterids (Silurian, Vic.) and several other occurrences (Silurian, NSW; Devonian, WA & Vic.), three species of spider (Cretaceous and Pliocene, Vic.), one opilionid (harvestman; Cretaceous, Vic.), and one mite (Pliocene, Vic.). Eurypterid trackways have been reported from the Silurian of Western Australia.

Chelicerates are a large and important group of arthropods which get a generally bad press in Australia on account of the few noxious living forms such as red-back and funnel-web spiders, scorpions mites and ticks. The repulsiveness of the living animals, however, is more than matched by their fossil relatives, which include the largest arthropods that ever lived: the eurypterids. At up to 2m long, and armed with huge pincers or spiny forelimbs, they were the dominant predators of mid-Palaeozoic seas. An excellent account of the lives of these creatures was given by Gill (1951), who included an inventory of Australian forms known to that date - but more on eurypterids later!

Chelicerates are distinguished from all other arthropods by a number of features including a lack of antennae; in their place is a pair of pincers, or chelicerae (Fig. 2B). These are extremely elongated in the largest eurypterids, the Pterygotidae. Note that the pincers of scorpions are not the chelicerae (which scorpions also have) but a specialised development of the second pair of appendages: the pedipalps. The pedipalps can be variously modified in the chelicerates - in male spiders they carry sexual organs. Behind the pedipalps on the body are four pairs of walking legs.

The oldest known chelicerate-like animals (though not true chelicerates because they apparently lack chelicerae) are the aglaspidids, which are known from the Cambrian of Tasmania (Jago and Baillie 1992; Quilty 1972; Fig. 1C). Among the most primitive of all the main lines of true Chelicerata, and also the longest surviving, are the Xiphosura: horseshoe crabs (or 'king crabs' as they are called by British zoologists, though they are not crabs at all, of course). Living horseshoe crabs can be found along the coasts of south-east Asia (*Tachypleus*) and eastern North America (*Limulus*) and fossils are known as far back as the Cambrian period. Xiphosura are comparatively rare as fossils (as are all chelicerates), so those known from Australia form a significant

FOSSIL CHELICERATES OF AUSTRALIA (Cont.)

contribution to our knowledge of the group. Specimens do turn up occasionally; one was found by workmen splitting flagstones of Devonian Mandagery Sandstone on the Bumberry Ridges, New South Wales (Pickett, 1993). This is currently the oldest fossil xiphosuran known from Australia. The next youngest is Paleolimulus from the Permian Jackey Shale of Poatina, Tasmania (Ewington, Clarke and Banks, 1989), which was found by a student on a field excursion from Launceston College. Though small, this inch-long specimen is nicely preserved in the shale which was laid down in a river during Australia's cold climate of the Permian. This find is the only known Paleolimulus from the southern hemisphere.

Triassic rocks have yielded two genera of Xiphosura which, so far, appear to be restricted to Australia: Dubbolimulus peetae Pickett, 1984, from middle Triassic rocks near Dubbo in the Sydney Basin, New South Wales (Fig. 1B), and Austrolimulus fletcheri Riek, 1955, from a similar horizon near Brookvale, New South Wales (Fig. 1A; see also Riek, 1968). Despite both animals occurring in sediments of similar lithology and age in the Sydney Basin, the animals could not be more different in appearance. Dubbolimulus is a fairly 'normal'-looking horseshoe crab but Austrolimulus is quite bizarre, with long genal spines more than twice the length of the animal.

The Cretaceous sediments of Koonwarra, South Gippsland, Victoria, are well known for the interesting terrestrial and freshwater plant and animal fossils they contain. Riek and Gill (1971) described a xiphosuran, Victalimulus mcqueeni, from a road cutting locality, where it was found by an amateur collector James McQueen. There is nothing odd about the appearance of Victalimulus, compared with other Mesozoic Xiphosura but, like the other Australian forms, it occurred in freshwater sediments. Most other fossil Xiphosura have occurred in near-shore marine environments, although living horseshoe crabs are known to travel many miles up estuaries to breed.

Additional Australian xiphosurans were described by Chapman (1932): Pincombella belmontensis from the Permian Belmont Beds of New South Wales, and Hemiaspis tunnecliffei from a road cutting in the Silurian rocks at Studley Park, Kew, Melbourne, Victoria. Careful re-examination of these specimens by John Pickett of the Geological Survey in Sydney revealed them both to be misidentified. Pincombella turned out to be part of a hemipteran insect (a bug), which are common in the Belmont Beds, and Hemiaspis tunnecliffei is actually a poorly preserved trilobite. Shortly after Chapman described these supposed horseshoe crabs from Permian and Silurian rocks, an apparently new genus of hemiaspid xiphosuran was found by amateur collector Mr. P. Junor in Silurian rocks of Kinglake West, Victoria. Withers (1933) named the fossil Rutroclypeus junori. However, this fossil proved later not to be of a xiphosuran, but a new carpoid echinoderm (Gill and Caster, 1960).

Eurypterids are extinct, having lived from Ordovician to Permian times. At their acme in the Silurian they were a very diverse group, including gigantic forms and types with scorpion-like tails, as well as small, streamlined animals (Fig. 1A,B). Most were swimmers, as evidenced by the typical paddle-shaped posterior limbs of many species, although the stylonuroids had stilt-like legs. McCoy (1899) described the first Australian eurypterid from a fragment of cuticle showing typical scaly ornament, found in a sewer trench in Domain Road, South Yarra, Melbourne. He named it Pterygotus australis but characters which could distinguish it from any other pterygotid eurypterid are lacking. The problem with most eurypterids is that they are large animals, so you are very lucky to find more than just a fragment, and whole animals are very rare. Collectors of dinosaurs have the same difficulty! The South Yarra Improvements produced further specimens which were described by Chapman (1910, 1914). Chapman also discovered that McCoy's holotype of Pterygotus australis had a number of small oval despressions on it which he described as Capulus melbournensis, a limpet-like gastropod which may have been a parasite or commensal on the Pterygotus (Chapman, 1929). Such a vision of a giant Pterygotus encrusted with epizoans cruising the Silurian seas brings to mind the barnacle-studded great whales (there are particularly fine examples at the entrance to the Queensland Museum in Brisbane).

Sewer trenches are not ideal places in which to collect fossils; that they are temporary excavations is but one inconvenience. A good place to find eurypterid fossils is in the many small quarries along the Yarra Track, which are famous for their abundant Silurian plant fossils. The association of early land plants and eurypterids is quite common, and points to the possible non-marine environments in which the eurypterids lived, or at least became buried after death. Eurypterids occur rarely in fully marine rocks with characteristic fossils, and are found in progressively more terrestrial environments later in their geological history. The collections at the Museum of Victoria in Melbourne contain many fragments of eurypterid collected at Cootamundra,

FOSSIL CHELICERATES OF AUSTRALIA (Cont.)

New South Wales. Gill (1951) identified these fragments as belonging to the genus Hughmilleria, a much smaller eurypterid than Pterygotus australis (which Gill estimated to have been about 70 cm long). Caster and Kjellesvig-Waering (1953) re-examined the Cootamundra eurypterid fragments and concluded that the largest piece probably belonged to Pterygotus (I agree), and the others were indeterminable. Quite possibly the Cootamundra locality is in the same horizon as that from which Pterygotus australis originated (Caster and Kjellesvig-Waering, 1953).

So far, this survey of the Australian eurypterid fauna has revealed no surprises. The eurypterids are quite similar to those which occur in Silurian rocks elsewhere in the world. But just as many of the Australian xiphosurans are weird, so the eurypterids have their oddballs too. Melbournopterus crossotus was described by Caster and Kjellesvig-Waering (1953) from the Silurian of Heathcote, Victoria (Fig. 2C). Only the carapace is preserved (although the authors mention many scraps of eurypterid in the same slabs) which is remarkable for its enormous, subrectangular eyes and frilled rear margin. The specimen comes from the Dargile Formation (Upper Silurian) and the siltstone preserving it is rich in monograptids. The graptolites confirm not only the Silurian age of the beds but also their marine nature.

Eurypterid remains in Australia are not confined to the Silurian nor are they exclusively south-eastern. A single eurypterid specmen is known from the Devonian Gogo Formation of Western Australia (Rolfe, 1966). The Gogo is famous for its calcareous nodules which yield exquisitely preserved fossil fish. The eurypterid has been referred tentatively to Rhenopterus by Waterston (in Rolfe, 1966) but is yet to be formally described. In addition, fragments of eurypterid have been reported from Lower Devonian siltstones at Middendorp's Quarry, Kinglake West, Victoria (Jell, 1992).

Before leaving eurypterids, mention must be made of their distinctive trackways. Eurypterid legs are of differing lengths and in most species the last pair are modified to function as swimming paddles. When they walk, eurypterids leave behind a trail of footprints in the mud or sand consisting of converging rows of 3 or 4 imprints, the outermost having a curved outline (the paddle). Circumstances which preserve the trackways are different from those in which body fossils of eurypterids are found - you almost never find a dead eurypterid at the end of its trail! In the deep gorge of the Murchison River at Kalbarri in Western Australia, bedding

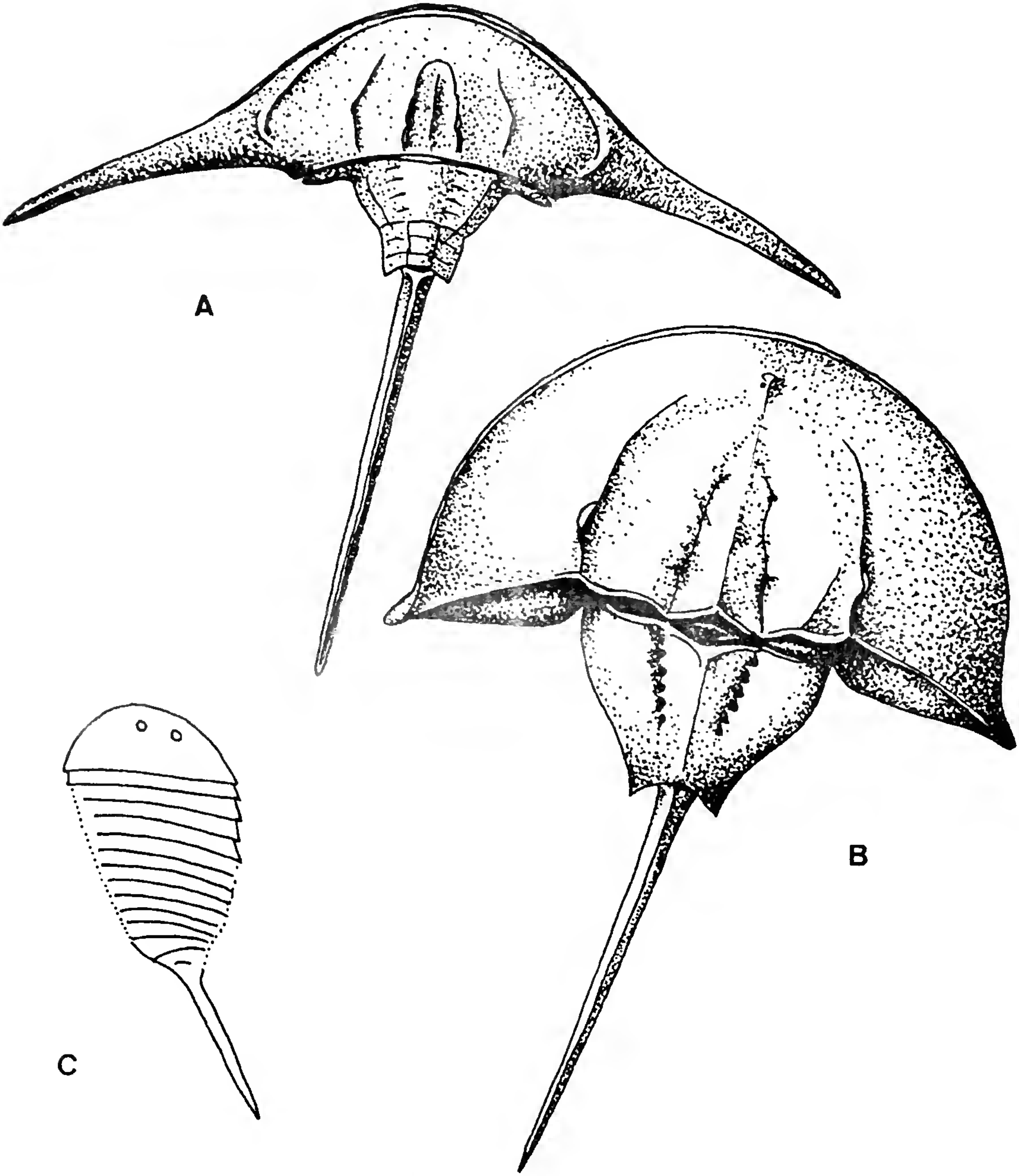


FIGURE 1. Australian Xiphosura (A, B) and Aglaspidida (C). A, Reconstruction of Austrolimulus fletcheri Riek, 1955, Triassic, NSW, dorsal aspect x 2/3 (after Riek, 1968); B, Reconstruction of Dubbolimulus peetae Pickett, 1984, Triassic, NSW, dorsal aspect, x 3 (after Pickett, 1984); C, Line drawing of Idamean aglaspidid from Tasmania, x 3 (after Jago and Baillie, 1992).

FOSSIL CHELICERATES OF AUSTRALIA (Cont.)

planes of ripple-marked, red Tumblagooda Sandstone (?late Silurian) are traversed by a wide range of arthropod trackways. Many of these were apparently made by eurypterids. A huge slab of the sandstone bearing the trails is on display at the Western Australian Museum, Perth, complete with a reconstruction of the type of eurypterid which might have made them. The eurypterids and other arthropods were apparently walking from pool to pool across emergent rippled sand surfaces, thus they were among the first animals to have walked on land, for which we have any evidence. The palaeoecology of the Tumblagooda Sandstone is currently under study by Nigel Trewin (Aberdeen University, Scotland) and Ken McNamara (Western Australian Museum, Perth).

Living terrestrial chelicerates are commonly referred to as arachnids. Arachnid fossils are even rarer than eurypterids and xiphosurans in Palaeozoic rocks. No Palaeozoic arachnids are known from Australia, but a few specimens have been found in Mesozoic and Cenozoic strata. The Cretaceous Koonwarra beds in Victoria have yielded a poor but recognisable opilionid (harvestman or harvest-spider; Jell and Duncan, 1986). In these animals the two body parts (prosoma and opisthosoma) appear fused into one blob, and the legs are commonly very elongated. The Koonwarra specimen has such a shape but cannot be placed with certainty into a lower taxon within the Opiliones.

Koonwarra has also produced two out of the three currently known fossil spiders from Australia (Jell and Duncan, 1986). Like harvestmen, true spiders have four pairs of walking legs, but unlike them their body parts are distinct and connected by a narrow pedicel. The Koonwarra spiders are recognisable as spiders but, like the opilionid, the family to which they belong cannot be determined.

The first fossil spider described from Australia was identified as belonging to the family Segestriidae and was named Ariadna resinae Hickman, 1957. Ariadna is a living genus which occurs in Victoria, Tasmania, South Africa, South America and Indo-China. The reason for the certainty of the identification is that the spider is very well preserved in amber of Pliocene age. Thus, not only are the taxonomic characters used in identification preserved but also the fossil is not very old. Indeed, the possibility exists that a living Ariadna resinae is still alive somewhere. Such spiders live in silken tubes in holes in trees. During the summer, males wander in search of females. Not surprisingly,

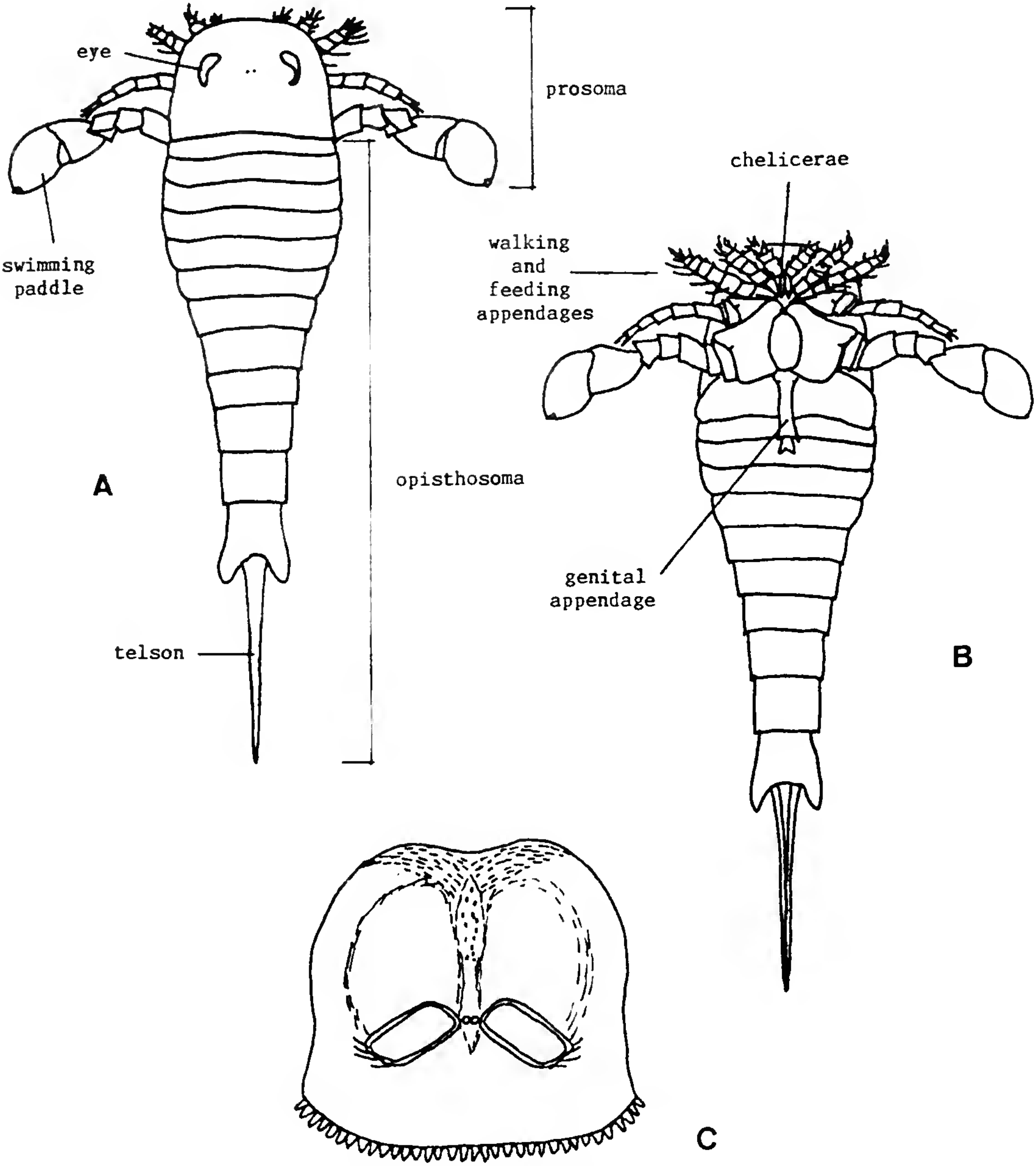


FIGURE 2. Eurypterida. A & B, reconstructions of Baltoeurypterus tetragonophthalmus Fischer, 1839, Silurian, Europe; A, dorsal aspect, B, ventral aspect, x 1/2 (after Størmer, 1955). C, Dorsal reconstruction of the carapace of Melbournopterus crossotus Caster and Kjellesvig-Waering, 1953, Silurian, Vic., x 1 (after Caster and Kjellesvig-Waering, 1953).

FOSSIL CHELICERATES OF AUSTRALIA (Cont.)

the fossil is of an adult male, presumably trapped in the sticky resin while on walkabout.

The piece of amber which produced the spider was a large (34 lb.) lump recovered from a mine at Allendale, Victoria. The resin seems to have flowed from a wound in a Kauri Pine (Agathis sp.). The amber piece contained many interesting fossils including leaves, a millipede, some insects, and a mite. Mites are also arachnids, but they turn up as fossils only rarely because they are so small. Not seen by regular collecting methods, only microscopic examination reveals them. The Pliocene mite from Allendale was, like the spider, placed in a living genus and called Acronothrus ramus Womersley, 1957. Living Acronothrus inhabit moss and humus, and the nearest species to A. ramus appear to be A. cophinarius from New Zealand.

Finally, the most impressive arachnid in the fossil collections at the Museum of Victoria, Melbourne, is an external mould of a huge huntsman spider (Heteropoda) in a sandy matrix. This came from a pile of stones in the Melbourne area, and therein lies the clue to its identity. Closer inspection reveals distinct bevels forming a low pyramid on the side of the slab which bears the spider. Clearly, the huntsman was lurking in the cavity of a brick when a dollop of mortar came down on top of it. The mortar set and the huntsman died, leaving its mould in the 'lime-cemented sandstone'. Years later, the wall was demolished and the recently formed huntsman 'fossil' came to light.

This survey of Australian fossil chelicerates is now complete and what it reveals is interesting. The few eurypterid specimens described in comparison with the many fragments reported and in collections suggests that many more could be found with little difficulty. There must be a few prize specimens lurking in the Silurian rocks. The Dargile Formation along the Yarra Track is worth searching, and some fragments have been found in Devonian rocks in western New South Wales. The xiphosuran fauna is particularly rich in comparison to the eurypterids; it includes some very unusual forms, and many occur in freshwater deposits. Arachnid fossils are sparse but tantalising. Non-marine deposits should be search for these; spiders are usually quite distinct (they look just like the squashed spiders) but may be faint and require wetting before they show up well on the bedding plane. Any amber is worth searching, of course. Because chelicerates are relatively rare as fossils it is not usually worthwhile to look for them specially, they normally turn up while collecting generally, or accidentally. It is only amateurs who can do this kind of collecting, and it is through their generosity, releasing fine specimens for study and donating collections to museums, that we have any knowledge of the chelicerate life of the past in Australia.

Acknowledgements: I am very grateful to the palaeontology staff of the major museums in Australia for their help and kindness during this survey; Ken McNamara (WA), John Long (WA), Neville Pledge (SA), David Holloway (Vic.), Frank Holmes (Vic.), Alex Ritchie (NSW), John Pickett (NSW), and Peter Jell (Qld.).

References

Caster, K. E. and Kjellesvig-Waering, E. N., 1953. Melbournopterus a new Silurian eurypterid from Australia. **Journal of Paleontology** 27: 153-156.

Chapman, F., 1910. A synopsis of the Silurian fossils of South Yarra and the Yarra improvement works. **Victorian Naturalist** 27: 63-70.

Chapman, F., 1914. **Australasian Fossils.** Melbourne.

Chapman, F., 1929. On a new species of Capulus found attached to a Pterygotus carapace. **Proceedings of the Royal Society of Victoria, new series** 41: 217-219.

Chapman, F., 1932. Two new Australian king-crabs. **Proceedings of the Royal Society of Victoria, new series** 44: 100-102; pl. XIV.

Ewington, D. L., Clarke, M. J. and Banks, M. R., 1989. A late Permian fossil horseshoe crab (Paleolimulus; Xiphosura) from Poatina, Great Western Tiers, Tasmania. **Papers and Proceedings of the Royal Society of Tasmania** 123: 127-131.

Fischer de Waldheim, G., 1839. Notice sur un crustace fossilé du genre Eurypterus de Podolie. **Bulletin de la Société des Naturalistes de Moscou** 11: 125-128.

Gill, E. D., 1951. Eurypterida-scorpions of the sea. A glimpse into the oceans of the distant past. **Victorian Naturalist** 68: 128-133.

Gill, E. D. and Caster, K. E., 1960. Carpoid echinoderms from the Silurian and Devonian of Australia. **Bulletins of American Paleontology** 41: 1-71.

Hickman, V. V., 1957. A fossil spider from Tertiary retinite at Allendale, Victoria. **Proceedings of the Royal Society of Victoria, new series** 69: 25-27; pl. VI.

Jago, J. B. and Baillie, P. W., 1992. An Idamean aglaspidid from north-western Tasmania. **Alcheringa** 16: 14.

Jell, P. A., 1992. Middendorp's Quarry; a classic Australian early Devonian fossil site. **The Fossil Collector** 38: 7-16.

Jell, P. A. and Duncan, P. M., 1986. Invertebrates, mainly fossil insects from the freshwater, Lower Cretaceous, Koonwarra Fossil Bed (Korumburra Group), South Gippsland, Victoria. **Memoirs of the Association of Australasian Palaeontologists** 3: 111-205.

McCoy, F., 1899. Note on a new Australian Pterygotus **Geological Magazine** 6: 193-194.

Pickett, J. W., 1984. A new freshwater limuloid from the middle Triassic of New South Wales. **Palaeontology** 27: 609-621.

Pickett, J. W., 1993. A late Devonian xiphosuran from near Parkes, New South Wales. **in press.**

FOSSIL CHELICERATES OF AUSTRALIA (Cont.)

Quilty, P. G., 1972. A Middle Cambrian xiphosuran(?) from western Tasmania. **Papers and Proceedings of the Royal Society of Tasmania** 106: 21-23.

Riek, E. F., 1955. A new xiphosuran from the Triassic sediments at Brookvale, New South Wales. **Records of the Australian Museum** 23: 281-282; pl.XIII.

Riek, E. F., 1968. Re-examination of two arthropod species from the Triassic of Brookvale, New South Wales. **Records of the Australian Museum** 27: 313-321.

Riek, E. F. and Gill, E. D., 1971. A new xiphosuran genus from Lower Cretaceous freshwater sediments at Koonwarra, Victoria Australia. **Palaeontology** 14: 206-210.

Rolfe, W. D.I., 1966. Phyllocarid crustacean fauna of European aspect from the Devonian of Western Australia. **Nature**,209: 192.

Størmer, L., 1955. Merostomata. p.4-41. In Moore R. C. (ed.). **Treatise on invertebrate paleontology.** Geological Society of America and University of Kansas Press, Lawrence, Kansas, xvii + 181 pp.

Withers, R. B., 1933. A new genus of fossil king crabs. **Proceedings of the Royal Society of Victoria, new series** 45: 18-22, pl. V.

Womersley, H., 1957. A fossil mite (Acronothrus ramus n.sp.) from Cainozoic resin at Allendale, Victoria. **Proceedings of the Royal Society of Victoria, new series** 69: 21-23.

THE QANTAS GREAT RUSSIAN DINOSAURS EXHIBITION

MUSEUM OF VICTORIA

(328 Swanston Street, Melbourne.)

14 AUGUST 1993 - 28 FEBRUARY 1994

Admission (including Museum entry)	
Adults	$10.00
Children/Concession	$ 6.00
Family - 2 adults, 2 children	$25.00
Family - 1 adult, 2 children	$20.00

An excellant 80 page catalogue with over 130 photographs, paintings, drawings and maps (sponsored by ICI) is available from the Exhibition Shop for $9.95.

After the Exhibition leaves Melbourne it will be on display in all State capitals as well as Darwin and Launceston, however, the exact itinerary has yet to be finalised.

THE QANTAS GREAT RUSSIAN DINOSAURS EXHIBITION 1993 - 1995

An Exhibition from the Palaeontological Institute (Moscow) in co-operation with the State Association 'Rossiya', the Monash Science Centre (Melbourne) and the Queen Victoria Museum (Launceston).

The following information is reprinted from the Exibition Catalogue (sponsored by ICI Australia) with the permission of the authors, Patricia Vickers-Rich and Thomas H. Rich.

The Qantas Great Russian Dinosaurs Exhibition is not only the largest dinosaur exhibition ever to visit Australia but also the largest fossil exhibition of all times to tour this continent. It is one of the biggest dinosaur exhibitions that has ever been put together on a world scale. Besides dinosaurs, this exhibition also includes a variety of mammal-like reptiles, the reptilian group which gave rise to mammals, including Homo sapiens. This material has rarely travelled outside of Russia.

HOW THE GREAT RUSSIAN DINOSAURS CAME TO AUSTRALIA

The Australian tour of The Qantas Great Russian Dinosaurs Exhibition began in Japan, in August 1992, when Professor Hasagawa of the National Museum of Japan introduced Dr. Patricia Vickers-Rich to Professor Alexi Rozanov and his team of Russian palaeontologists. Professor Rozanov had brought a wonderful collection of dinosaur and mammal-like reptile bones for public display to Tokyo and several other venues in Japan - with the sponsorship of the Fuji Television Network. Because of the size and quality of the collections, and the fact that they were already prepared for travel, negotiations began immediately to arrange an Australian tour with the help of the Russian State Association 'Rossiya' directed by Mr. Vladimir Yevstigneev.

Final arrangements were made in Moscow during May, 1993, between the Russian Palaeontological Institute and the State Association 'Rossiya' on the one hand and the Monash Science Centre and Queen Victoria Museum on the other, to bring this magnificent collection of genuine fossil material to several museums in Australia. Currently the Exhibition is on display at the Museum of Victoria in Melbourne.

The exhibition is magnificent in itself, but, in addition, it has provided a unique opportunity for the development of educational material for both Australia and Russian schools. Further-

RUSSIAN DINOSAURS EXHIBITION (Cont.)

more, it has allowed the initiation of several scientific exchanges between the Russian and Australian institutions. Russian scientists will be in residence at each of the museums where The Great Russian Dinosaurs are on display, working with Australian scientists on joint research and field projects. Future exchanges between both countries are already in the planning stages, as are further public displays, and a co-operative casting programme of the dinosaur material on display.

MAMMAL-LIKE REPTILES AND DINOSAURS: THE STARS OF THE SHOW

Two major groups of reptiles are present in The Great Russian Dinosaur Exhibition - the mammal-like reptiles and the dinosaurs. What is so unique about each of these groups? How can they be told apart?

Biologists trying to determine just how groups of reptiles are related to one another have used the structure of the skull to divide them into four basic groups:

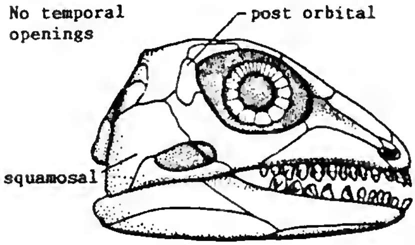
- turtles (anapsids) and other quite primitive reptiles that have no openings in the back of their skulls.
- mammal-like reptiles (synapsids) that have one opening in the back of their skulls which lies below a bar of bone (the post-orbital bar, always formed by two bones, the post orbital and squamosal) just behind the eye socket (orbit).
- ichthyosaurs and plesiosaurs, aquatic reptiles (euryapsids) that have one opening in the back of their skulls that lies above the bar of bone behind the eye socket.
- dinosaurs, spenodonts (New Zealand Tuatara), lizards and snakes, as well as many other groups, that have two openings in the back of the skull (diapsids), one above and one below the bar of bone behind the eye socket.

There were two kinds of mammal-like reptiles, both are present in The Great Russian Dinosaur Exhibition - the primitive pelycosaurs and the more advanced therapsids. In the Exhibition there is one representative of the pelycosaurs Ennatosaurus, while all of the other mammal-like reptiles are therapsids. The pelycosaurs which first appeared in the Carboniferous, became very successful in the Early Permian. The group to which Ennatosaurus belongs, the caseids, were herbivorous and probably cold-blooded animals. Some of their close relations had bony spines of the vertebrae that extended for up to a metre above the animal, supporting a sail-like structure. These sails probably allowed the animals to heat up or cool off quickly depending on how they oriented themselves to the sun, so as to give them some sort of temperature control.

Therapsids were the more advanced mammal-like reptiles that eventually gave rise to the mammals. The therapsids included a great variety of both carnivores and herbivores. They had a very large opening at the back of the skull, their jaw joint moved forward and throughout their history they evolved towards the mammalian condition. The change this involved was the loss of all bones in the lower jaw except the dentary, which is the only one present in mammals. There was a trend towards incorporation of some bones that were part of the upper and lower jaw, the articular and the quadrate, into the middle ear. In mammals the articular becomes the malleus and the quadrate the incus, both small bones of the middle ear that, together with the stapes, transmit sound from the eardrum to the nerve endings in the inner ear so that hearing occurs! The limb bones and the vertebrae also changed to produce an animal with legs tucked in under the body instead of in a sprawling stance out to the side - a much more energy efficient way to move and much more mammalian.

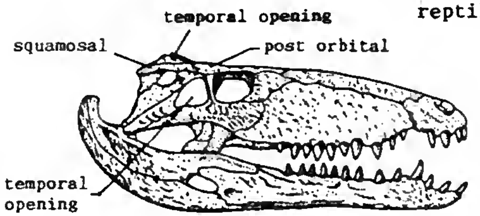
Several therapsid groups are represented in the Exhibition. The **Biarmosuchidae**, the most primitive therapsids, are a poorly known group from the Late Permian of Russia. They were small carnivores that resembled some of the pelycosaurs. They had canines as well as a reduced number of marginal teeth, and still had a few teeth on their palate. The **Ecotitonosuchidae** are another primitive therapsid group that were carnivores in the Permian of Russia - with large canines, a few teeth along the side of the jaws as well as incisors and even teeth on the palate. The **Gorgonopsia** were the main carnivores of the Late Permian known from South Africa and Russia. They were all very similar, most being about the size of a large dog, and very alike in appearance to the sabre-tooth cats that evolved much later. Palaeontologists cannot agree on the exact relationships of this group; some think gorgonopsians were relatives of primitive therapsids, while others think they belonged with the advanced forms. The **Dinocephalia** are a diverse group known from the Late Permian of Russia and South Africa and include both carnivores and herbivores. The **Dicynodontia** were the dominant plant-eaters in the Late Permian, with a number of forms appearing in the Triassic. These were the ecological counterparts of the large, grazing mammals of today. The **Cynodontia** were direct ancestors of the mammals and arose

RUSSIAN DINOSAURS EXHIBITION (Cont.)



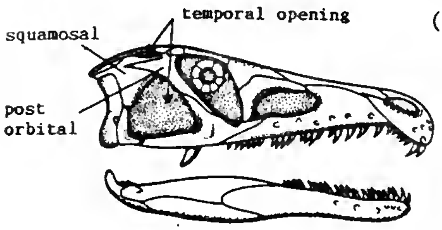
ANAPSID

(turtles & primitive reptiles)

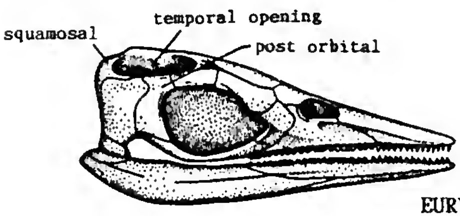


DIAPSID

(crocodile)

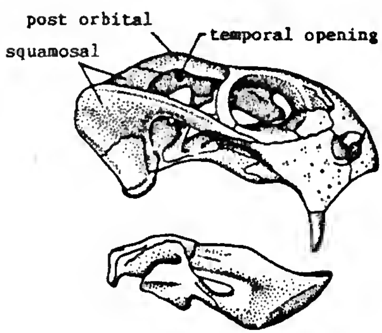


DIAPSID



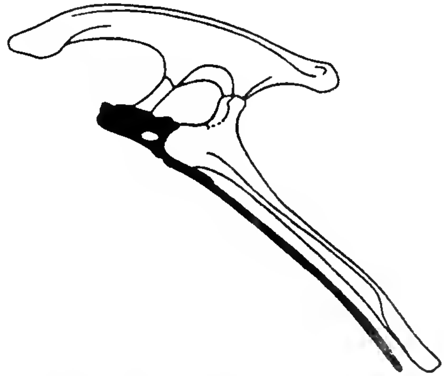
EURYAPSID

(extinct ichthyosaurs & plesiosaurs)

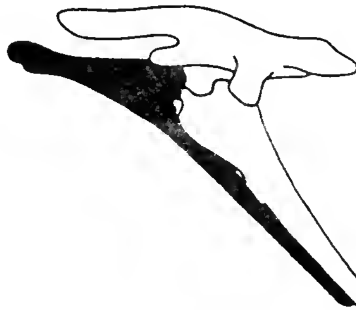


SYNAPSID

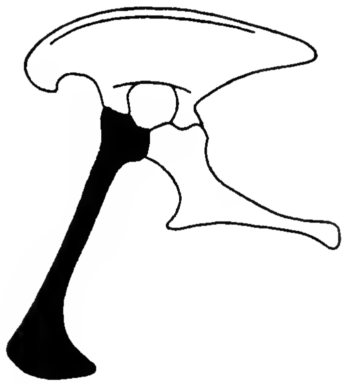
(extinct mammal-like reptiles)



BIRD-HIPPED DINOSAUR



BIRD-HIPPED DINOSAUR



LIZARD-HIPPED DINOSAUR

in the Late Permian to diversify in the Triassic. Their braincase and temporal region of the skull had expanded, the opening in the back of the skull had greatly enlarged and the dentary became the major bone in the lower jaw.

Dinosaurs are familiar to nearly everyone. They were a group of diapsid reptiles, that is they had two openings in the back of the skull. Although their name means 'terrible lizard' not all were terrible (some were peaceful herbivores) and none were lizards. Dinosaurs, in fact, belong to a group of reptiles called **archosaurs**, 'ruling reptiles'. Lizards belong to another group of diapsid reptiles separate from archosaurs, called **lepidosaurs.** Archosaurs are distinguished by having many extra openings in the skull, one or more in front of the eye sockets and one or more in the lower jaw. The purpose of these openings is not clear - but they may have been a way of making the skull lighter. The teeth of archosaurs are set in deep sockets in both of the jaws.

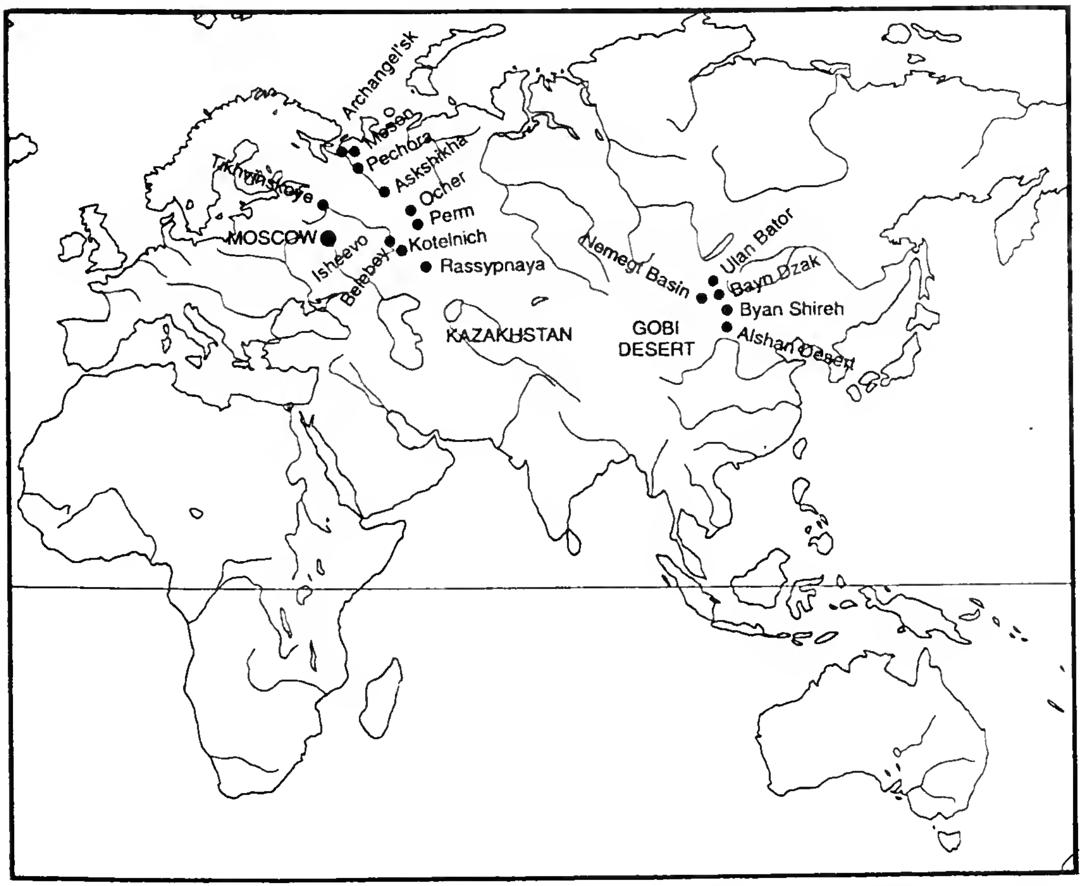
The oldest known dinosaurs come from the Triassic of South America, in rocks about 230 to 225 million years old. However, the dinosaurs in the Exhibition are all from the near the end of the reign of dinosaurs, the Cretaceous Period, from about 125 million years to about 70 million years ago. Represented are the two great groups of dinosaurs, the **Saurischia** and the **Ornithischia.** The saurischians were the lizard-hipped dinosaurs including both the large, 'Brontosaurus'-like sauropods and the fierce carnivores like Tarbosaurus which is on display in this exhibition. They had the most primitive pelvic arrangement with a three-pronged structure where the pubis points forwards and the ischium back, similar to that of the archosaur group that gave rise to the dinosaurs. In this exhibition several groups of saurischians are represented including the small to medium-sized carnivores, the **dromaeosaurs** and the bird-like Avimimus, whose relationships are not clearly understood. Also present are the toothless **oviraptosaurs** with parrot-like beaks; the **ornithomimosaurs** (ostrich-like dinosaurs); the characteristic large theropods like Tarbosaurus; and the enigmatic **therizinosaurs** with their elongate fingers, which may have enabled them to pull down branches for browsing on.

FIGURE 1. Far left: Different types of reptile skulls. The number and location of temporal openings in the back of the skull is a clue to what reptile is related to another. The holes lighten the skull and the borders of the holes serve as areas of muscle attachment. Left: Different types of dinosaur hip-bones (pelves). The hip structure is important in determining relationships of dinosaurs, especially the shape of the pubis (in black), one of the three bones that make up the pelvis.

RUSSIAN DINOSAURS EXHIBITION (Cont.)

In the ornithischians, by contrast, the pubis had a branch that ran backwards in parallel with the ischium, and in many a projection of the pubis that pointed forwards (the prepubic process) developed as well. Ornithischians included only herbivorous forms and represented in this exhibition are the bipedal **Ornithopoda** (iguanodontids and duck-billed dinosaurs), the **Ceratopsia** (horned and frilled dinosaurs), the **Ankylosauria** (armoured dinosaurs) and the **Pachycephalosauria** (the dome-headed dinosaurs).

In addition to these sorts of pelvic structure, all dinosaurs has a number of bony specialisations that led to an upright posture not a sprawling stance. The legs were in close to the midline of



Map of fossil localities producing mammal-like reptiles and dinosaurs in Russia and Mongolia that are on display in the Qantas Great Russian Dinosaurs Exhibition.

the body and because of this change in posture and shape of the pelvis, and in the way the leg articulated with the pelvis, the knee and ankle joints became simple hinge joints (Benton,1990). The vast majority of dinosaurs stood up on their toes (a digitigrade stance) most of the time rather than flat on their feet (a plantigrade stance). Many of the specialisations that dinosaurs developed, were similar to those attained by the mammal-like reptiles and their descendants mammals - but of course they developed separately and at a different time.

LIST OF MATERIAL ON DISPLAY AT THE EXHIBITION

RUSSIAN DINOSAURS AND ASSOCIATED FOSSILS
(Cretaceous: 145 - 65 million years ago)

Dinosaurs
Large carnivorous dinosaur (tyrannosaurids)
Tarbosaurus bataar (skeleton, skull, forelimb, braincase)

Small, agile carnivorous dinosaur (dromaeosaurus). Principal protagonist in the film 'Jurassic Park'.
Velociraptor mongoliensis skull

Bird-like small theropod dinosaurs, the ornithomimosaurs and oviraptorosaurs
Avimimus portentosus skeleton
Ingenia yanshini skull
Gallimimus bullatus skeleton

Clawed dinosaur, a therizinosaurid
Therizinosaurus cheloniformis claw
Deinocheirus mirificus arms with hands and claws

Sauropod dinosaur (relative of Apatosaurus, which is the correct name for Brontosaurus.
Nest of sauropod eggs

Armoured dinosaurs, ankylosaurs
Talarurus plicatospineus skeleton
Tarchia kielanae skull
Saichania chulsanensis skull & tail
Homalocephale calathocercos skull (cast)
Prenocephale prenes skull (cast)
Shamosaurus scutatus skull, scutes

Large, primitive bipedal herbivorous dinosaur, ancestral to hadrosaurids
Iguanodon orientalis skull

Duckbilled dinosaurs, hadrosaurids
Probactrosaurus gobiensis skeleton
Arstanosaurus sp., skeleton
Saurolophus angustirostris skeleton
Saurolophus skin imprint
Corythosaurus convincens skeleton
Nest of hadrosaur eggs

Parrot-beaked dinosaur, bipedal ancestor to frilled-necked dinosaur
Psittacosaurus mongoliensis skeleton

Frill-necked dinosaurs, neoceratopsians
Protoceratops andrewsi large skeleton, small skeleton & skulls.
Nest of protoceratopsid eggs
Bagaceratops skull.

Crocodile
Shamosuchus skull

Bird
Gobipteryx eggs

Mammal (a primitive mammal - a multituberculate)
Djadochtatherium skull

Turtle
Mongolemys carapace (shell)

Invertebrates
(animals without backbones)
Buginella shells, 5 pieces
Plicatotrigonioides shells, 5 pieces
Sainshandia shells, 5 pieces

RUSSIAN DINOSAURS EXHIBITION (Cont.)

Stychopterus exoskeleton
Dragonfly Hemeroscopus 1 piece
Ephemeropsis insect
Coptoclava larva, 1 piece
Gurvanichthys 2 pieces
Lycoptera, 2 pieces

Plants
Nyssoidea fruits, 5 pieces
Nelumbo leaves, 1 piece
Ginkgo leaves, 1 piece

RUSSIAN MAMMAL-LIKE REPTILE AND ASSOCIATED FOSSILS (Permian and Triassic: 290 - 208 million years ago)

Amphibians
Temnospondyl amphibians
Platyoposaurus stuckenbergi skull
Thoosuchus jakovlevi 2 skulls
Benthosuchus korobkovi skull

Reptile or Amphibian
Primitive reptile to some scientists; to others an amphibian
Lanthanosuchus watsoni skull

Reptiles
Thecodont, a primitive reptile group that gave rise to many other reptiles, such as dinosaurs.
Garjainia triplicostata skeleton

Procolophonian, a primitive group of reptiles
Nyctiphruretus acudens skeleton

Pareiasaurs, an ancient group of reptiles related to turtles.
Scutosaurus karpinskii large and small skeletons

Primitive reptile related distantly to dinosaurs and birds (a primitive diapsid)
Mesenosaurus romeri skeleton

Primitive mammal-like reptile, a pelycosaur
Ennatosaurus tecton skeleton, skull

Advanced mammal-like reptiles, dinocephalians
Estemmenosuchus uralensis skeleton
Estemmenosuchus mirabilis skull
Ulemosaurus svijagensis skeleton
Titanophoneus potens skeleton

Advanced mammal-like reptiles, eotheriodonts
Biarmosuchus tener skeleton
Eotitanosuchus olsoni skull
Inostrancevia alexandri skeleton

Advanced mammal-like reptiles, dicynodonts
Dicynodon trautscholdi skull
Lystrosaurus georgi skeleton

Advanced mammal-like reptile, an anomodont whose relationships with other reptiles is not clear.
Suminia getmanovi skeleton

Advanced mammal-like reptiles, cynodonts
Dvinia prima skull

Nodules from the North Dvina River

THE ALLENDALE RESIN SPECIMEN: A LITTLE KNOWN TERTIARY FOSSIL FROM VICTORIA

Information compiled by **Frank Holmes**

The occurrence of insects and other fossils preserved in amber is well known from the Baltic Sea, Dominican Republic and Tanzania, and to a lesser extent Arkansas (USA) and Mexico. It was not until I received the article "Fossil Chelicerates of Australia" by Paul Sheldon (this Bulletin, page 11) that I became aware that identifiable plant and arthropod remains had been discovered in Victoria, preserved in fossil resin.

The following additional information on this early discovery is based on papers by E. Sherbon Hills and others, published in the Proceedings of the Royal Society of Victoria, 1957.

Origin

The specific locality and date of discovery of the Allendale resin specimen is not known with any certainty. However, Hills notes that it may have been obtained from the same locality and at the same time as specimens of wood and retinite (fossil resin) reported by F. M. Krause as having been found in the Madam Berry West Company shaft, Smeaton, Victoria (Annual Report of the School of Mines, Ballarat, for 1894).

All that is known of the Allendale specimen's derivation is given in Watson (1925), who stated that the resin "came from the deep leads, where part of the formation consists of black clays in which logs still retaining their woody structure are occasionally found some 300 feet (90 metres) below the surface and overlain by three flows of basalt."

Description

When Hills inspected the specimen it weighed 34 lbs (15.5 kgs) and appeared practically complete. A 9 lb. (4 kg.) sample, having been selected as likely to yield fossils, was detached from near the base and broken up into pieces small enough to be transparent under a beam of light. It was then examined and prepared by a Mr F. Hallgarten, who

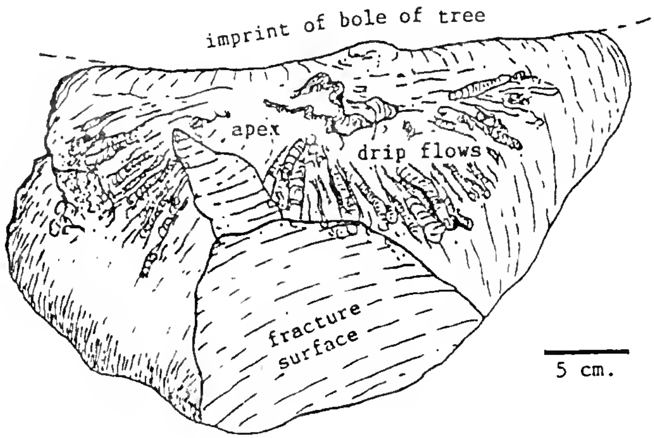


FIGURE 1. Drawing of the Allendale resin specimen (adapted from Hills, 1957).

extracted the fossils by cutting the resin with a hot wire.

Specimens of the resin submitted to the Sydney Technological Museum in 1945 where reported to belong to the alcohol- soluble, hydrocarbon-insoluble class, comparable with the resins of Callitris (Bunya & Hoop Pine), Araucaria (Cyprus Pine) and Agathis (Kauri Pine) among extant Australian flora. Hills noted that the structure of the specimen indicated it was derived from one large tree, most likely Agathis, based on leaves of this genus found embedded in the resin. Distinct flow-layers, resin drips and the near vertical and gently curved imprint of the bole of the tree are clearly visible.

Fossils found in the Allendale resin specimen.

Gymnosperms:

Agathis yallourensis Cookson and Duigan, 1951. A leaf imbedded in the kauri-gum was found to be still green, although chlorophyll was slightly yellowish, and the texture very similar to fresh material (Patton,1957).

Angiosperms:

? Genus. Broad dicotyledonous leaf.

Arthropods:

Class Diplopoda (millipedes). Spirpbolus? sp. - single specimen 4 cm. long and numerous fragments. The primary

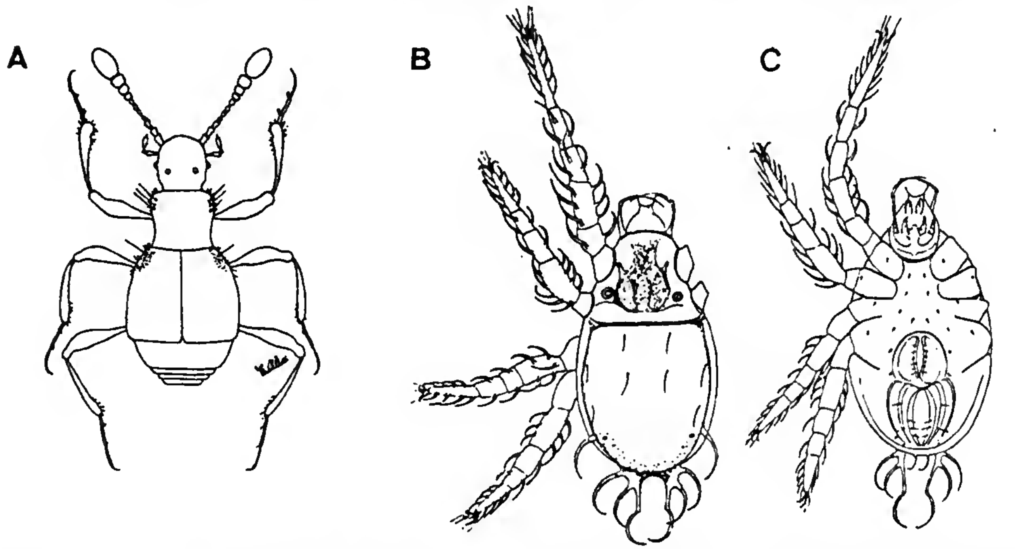


FIGURE 2. A, dorsal surface of the Allendale beetle specimen Eupines setifera (after Oke, 1957); B, dorsal surface and C, ventral surface of the Allendale mite specimen Acronothrus ramus (after Womersley, 1957).

specimen shows about 40 segments with legs visible in places. A second specimen contains the head and some anterior segments (Tiegs, 1957).

Class Arachnida

Order Acarina (mites). Acronothrus ramus Womersley, 1957 - single adult? female specimen 700 microns long.

Order Araneae (spiders). Ariadna resinae Hickman, 1957 - single adult male specimen with oval carapace 3.2 mm. long and six oval shaped eyes arranged in three pairs.

Class Insecta

Order Coleoptera (beetles). Family Pselaphidae - Eupines setifera Oke, 1957; Family Tenebrionidae - Platycilibe brevis Carter, fairly well preserved specimen; Family Scymaenidae - ? Genus, fairly large specimen but with missing prothroax making identification impossible; Subfamily Cryptohychinae - ? Genus, moderate sized weevil specimen with antennae and tarsi missing (Oke, 1957).

Order Hymenoptera. Family Formicidae (ants) - Ponera scitula Clark, single specimen in fairly good condition; Iridomyrmex sp., small blackish specimen of this genus too damaged for specific identification. Family Belytidae? - parts of a damaged specimen probably belonging to this family (Oke, 1957).

Ecological conditions

According to Hills, the fossils all indicate moist climatic conditions and despite the presence of living species of insects which might indicate a very young geological age, the climate was very different from that existing in Victoria today, Agathis now being restricted to tropical and sub-tropical regions in Australia and New Zealand.

Geological age

The age of the Newer Volcanic basalts beneath which the resin specimen was found is presumed to range, at various localities, from mid-Pliocene to Holocene. The flows about Allendale are not among the youngest of the volcanic suite and therefore might reasonably be regarded as Pliocene or Pleistocene (Hills, 1957).

References

Hickman, V. V., 1957. A fossil spider from Tertiary retinite at Allendale, Victoria. Proceedings of the Royal Society of Victoria 69: 25-27, pl.6.

Hills, E. Sherbon, 1957. Fossiliferous Tertiary resin from Allendale Victoria. **Proceedings of the Royal Society of Victoria** 69: 15-20, pl.3-5.

Patton, R. T., 1957. Appendix 1 - Green leaf from fossil resin, Allendale, Victoria. Pp.18-19 in Hills E. S., Fossiliferous Tertiary resin from Allendale Victoria. **Proceedings of the Royal Society of Victoria** 69.

Tiegs, O. W., 1957. Appendix 2 - Report on Millipedes from fossil resin, Allendale, Victoria. P.20 in Hills E. S., Fossiliferous Tertiary resin from Allendale Victoria. **Proceedings of the Royal Society of Victoria** 69.

Watson, J. C., 1925. Fossil resins (retinite) from Yallourn, Allendale, and Lal Lal. **Records of the Geological Survey of Victoria** 4(4): 484-485.

Womersley, H., 1957. A fossil mite (Acronothrus ramus n. sp.) from Cainozoic resin at Allendale, Victoria. **Proceedings of the Royal Society of Victoria** 69: 21-23.

IN THE NEWS

LIVING GRAPTOLITE DISCOVERED ?

During the 1989 French Calsub Expedition, the submersible 'Cyana', working in deep water off New Caledonia, half way between Brisbane and Fiji, brought to light an extant pterobranch (a colony-forming hemichordate) that has an astonishing physical resemblance to graptolites, a group considered to have been extinct since the Carboniferous. The pterobranchs were found encrusting the surface of the coral Vermiliopsis associated with Dendrophyllia.

The new species of pterobranch, named Cephalodiscus graptolitoides by Dr P. N. Dilly from the Department of Anatomy, St George's Hospital Medical School, London, is of considerable interest because it has long needle-like spines extending perpendicularly from the coenecium (the tubular exoskeleton of colonies of pterobranches). These spines are reminiscent of the spine-like structure called the nema, which are a feature of several groups of extinct graptolites.

According to Dilly, this is the first time this feature has been described in the pterobranches and could resolve the long-standing arguments among palaeontologists as to how the fossil graptolites

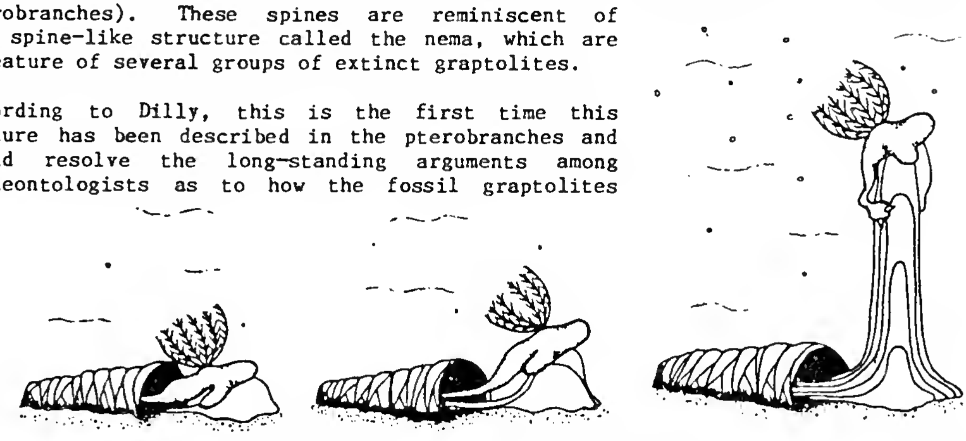


Diagram suggesting the mechanism for the secretion of the spines by the zooids during excursion from their coenecial tubes. (From Dilly, P.N., 1993. **Journal of the Zoological Society of London** 229, p.76) produced their extra-corporal homes. In the past, the general hypothesis has been that the graptolite zooids could not have constructed the nema because they were somehow passive prisoners in their cell-like tubes (theca) being attached to others in the colony by soft tissue. Indeed, in many late graptolite species the external aperture to each theca is constricted.

Dilly believes that with Cephalodiscus graptolitoides, the zooid (the soft bodied individual inhabiting the coenecial tube, or theca in the case of graptolites) squeezes through the restricted aperture of its coenecial tube to construct, with other zooids, a spine up to 30 times its own length. As an individual zooid climbs up the spine it leaves a thin trail of material on the surface, much like a snail track, and when at the tip secretes a globule of material from its cephalic shield, thus extending the length of the spine. This oval globule then provides the template upon which more spine material is deposited during the next zooidal trip. The spines seem to function as a pole from which the zooids can feed in water away from the surface of the sessile colony.

Based on the overall study of C. graptolitoides, Dilly considers "Their is little if any reason for not considering C. graptolitoides as a living fossil and a member of the graptolites previously thought to be extinct for over 300 million years".

References: Dilly, P. N., 1993. Cephalodiscus graptolitoides sp. nov. a probable extanct graptolite. Journal of the Zoological Society of London 229: 69-78.

Rigby, S., 1993. Graptolites come to life. Nature 323: 209-210.

PSST, WANT A CHEAP FOSSIL?

The current dinosaur boom, which started two to three years ago, continues to grow. For instance some 25,000 people attended the fifth annual Tokyo International Mineral Fair, where several millions of fossils and other dinosaur-related items were on display. But an amateur palaeontologist laments that the dinosaur boom has sent fossil prices through the roof. Unfortunately it appears that the modern-day supply and demand principle applies to fossils too.

In addition to an increasing number of ordinary people buying fossils, the growing number of new natural science museums has also added fuel to the fossil price spiral, and created new business opportunites.

A number of small companies now specialize in importing fossils and recently the giant trading house, Mitsui & Co., has entered this growing market. "Fossils are good business. We are now embarking on a project, together with a biochemical research company, to create in Japan the world's largest dinosaur museum," a Mitsui official said.

Compared with the growing demand, supplies are limited. Due to the effects of volcanic activity, fossils are not easy to find in Japan.

Eventually fossil dealers and collectors have to turn to foreign imports. And for those rare fossils whose export is prohibited? Well, there's always the black market.

Take for example the case of the prefectural natural science museum near Tokyo that in 1990 purchased six 700 million year old fossils from an Australian dealer, only to later find out that the export of fossils from Australia was prohibited (without a permit, ED.).

(Cont.)

PPST, WANT A CHEAP FOSSIL (Cont.)

The museum cancelled the purchase contract and returned the fossils to the Australian Embassy in Tokyo. Unlike regulations on trade in rare animals and plants, there are no international agreements to regulate the export or import of fossils. Japan has no restrictions on fossil imports.

"It is an open secret that smuggled fossils are in circulation all over the world," a well informed source acknowledged.

Report in The Japan Times Weekly International Edition July 19 - 25, 1993. (Submitted by Alan Rix)

CANADIAN DINOSAUR STAMPS

On October 1st, 1993, the same day Australia Post releases its special stamp issue depicting six Australian Early Cretaceous dinosaurs, Canada Post releases the third in a series of stamps on Canadian pre-history. The stamps feature four dinosaurs discovered in various parts of Canada, namely:-

Massopondylus: a 3 - 5 metre long herbivore, the only dinosaur known to have lived in the eastern regions of Canada.

Albertosaurus: a slightly smaller version of the carnivorous Tyrannosaurus that lived in Alberta between 83 and 65 million years ago and reached lengths of 10m. from head to tail.

Styracosaurus: sized between the bull hippo and bull elephant, it roamed Alberta and Montana approximately 76 million years ago, and was characterized by its rhino-like horn and long spines on its head frill.

Platecarpus: a Cretaceous Period marine reptile which looks something of a cross between a lizard and a seal. This member of the Mosasaur family was approximately 6m. long, and used its eel-like tail and powerful flippers to catch its fishy prey.

The first set of four stamps in the series (issued in 1990) was entitled the "Age of Primitive Life" and the second set (issued in 1991), the "Age of Primitive Vertebrates". A fourth and final set will depict the "Age of Mammals".

BIBLIOGRAPHY AND LIST OF AUSTRALIAN FOSSIL ECHINOIDS PUBLISHED

Over 330 references to papers and other manuscripts containing taxonomic and locality information on Australian fossil echinoids are listed in a comprehensive annotated bibliography recently published in the **Occasional Papers of the Museum of Victoria.** Based on this information a separate list of genera and species records 167 echinoid taxa from the continent's marine deposits, excluding undescribed species listed by Philip (1970).

The annotated 'description of contents' of each reference in the bibliography, where applicable, lists the publshed generic and specific names, locality names, age and spelling used as well as page and plate numbers. The abridged synonomy contained in the list of genera and species enables the reader to determine the currently accepted binomial nomenclature.

Reference: Holmes, F. C., 1993. Australian fossil echinoids: annotated bibliography and list of genera and species. **Occasional Papers from the Museum of Victoria** 6: 27-53.

Copies of the Occasional Papers are available from the Museum of Victoria Library, 285-321 Swanston Street, Melbourne, Victoria, 3000, for AUS$15.00 including postage.

DINOSAUR FOOTPRINTS OLDEST IN JAPAN

Dinosaur footprints discovered last May in Shimonoseki, Yamaguchi Prefecture, are believed to be the oldest ever found in Japan, according to Yoshihiko Okazaki, a researcher at Kitakyushu Museum of Natural History.

According to Okazaki the footprints date from the Late Jurassic Period about 140 million years ago. Dinosaur footprints found previously are mostly of Cretaceous age.

The Shimonoseki prints were discovered on the city's Yoshimo beach on May 23rd by a 26 year old dental technician, Masafumi Kurokawa, from Iizuka, Fukuoka Prefecture. Kurokawa asked the Museum to examine the marks which turned out to be the footprints of two dinosaurs, both of which had three toes.

The bigger footprints measure about 30cm. by 30cm. and the smaller 25cm. by 25cm. and are believed to have been made by the dinosaurs' hind feet. The larger footmarks are considered by Okazaki to be those of a herbivore, such as an Iguanodont, and the smaller ones those of a carnivore, such as a Megalosaur. Fern fossils found near the 8cm. deep footprints have also been dated as Jurassic.

Footprints found in August, 1992, at Katsuyama, Fukui Prefecture, were at that time the oldest known in Japan, dating from the Early Createaceous about 130 million years ago.

Based on a report in the Japan Times Weekly, International Edition, July 26 - August 1, 1993. (Submitted by Alan Rix)

NEW TRIASSIC FOSSIL INSECT GENUS NAMED AFTER FCAA MEMBER

A well preserved homopterous nymph collected by Robert Knezour from plant fossilrich mudstones at a disused quarry at Dinmore, Queensland, in the Ipswich Basin, has recently been named Knezouria unicus.

The sediments in which the specimen was found belong to the Blackstone Formation of the Ipswich Coal Measures. Palynological data suggests a Late Triassic (Carnian) age (de Jersey, 1970). Details of stratigraphy and age of the deposit were given by Rozefelds and Sobbe (1987) who noted three major insect groups (Blattodea, Hemiptera and Coleoptera) associated with a typical Dicroidium macroflora.

Ventral surface of Knezouria unicus (holotype) x 6.

A homopterous form is suggested for Knezouria unicus, based on the head with the rostrum arising from the frons near the rear of the head, but its relationships are uncertain because comparable nymphs are extremely rare in the fossil record. Of the several homopterous nymphs known (mainly Sternorrhyncha) none are similar to the new form which is reported as more like an Auchenorrhyncha nymph. Comparison with nymphs of Recent forms is only superficial due to several critical features being unclear on the fossil. However, a similarity to Fulgoroidea is suggested.

Reference: Jell, P. A., 1993. Late Triassic homopterous nymph from Dinmore, Ipswich Basin. **Memoirs of the Queensland Museum** 33(1): 360.

BOOKS AND BOOK REVIEWS

WILDLIFE OF GONDWANA by Patricia Vickers-Rich and Thomas H. Rich. Published by Reed Books Australia (1993), a part of William Heinemann Australia, Chatswood, N.S.W., 276pp. Recommended retail price - hardcover AUS$59.95. [ISBN 0 7301 0315 3]

Wildlife of Gondwana re-creates the environments of pre-historic Australia, when winter nights lasted six weeks, and when pygmy allosaurs, ornithomimosaurs, horned dinosaurs, giant sauropods and freshwater dolphins inhabited the region.

It traces the story of the vertebrate faunas that inhabited Gondwana, the great southern landmass, beginning with the origin of life in Precambrian times, more than 3.5 billion years ago, and following evolution from primitive fish to advanced mammals and birds. Research for the book was done not only in Australia, but in such far-flung places as Argentina, China and the U.S.A.

The book has been written to appeal to a wide readership and contains 475 colour photographs and 75 other illustrations. The result is an easy-to-read, jargon-free account of Gondwanan vertebrate wildlife.

Information supplied by the publisher.
