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BULLETIN No.46 SEPTEMBER 1995

A reconstruction of the Late Jurassic bird *Confuciusornis sanctus*, from China. See page five for more.

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EDITORIAL NOTES

Welcome to Bulletin 46 and my second bulletin as editor. I have to admit that when it first became known that I was taking on the job of editor, many people told me I was crazy and that I was brave for deciding to volunteer for such a task. Now that the first bulletin (Bulletin 45) I worked on is out and has been read I am happy to say that being the editor of The Fossil Collector is in no way as bad as people think. Actually it is quite a thrill to see something that I helped create be printed and sent to both the professional and amateur communities.

Now that my wedding and field trips are over, the non-stop pace of the last few months has given way to a life of quietness and a feeling of being in control again, if ever possible. The two field trips I was part of over the June - July period were both extremely good fun and with regard to new finds, both trips were a complete success. Many thanks to my wife Julie, our American friends Chris and Dawn Schur for the success of the first trip and the staff and volunteers of the Queensland Museum who made the second trip a success. If the volunteers of museums in other states should ever have the chance of attending a museum lead field trip, go on it. I shall write more about these two experiences in a future bulletin.

In the Editorial Notes of Bulletin 45 I made comment that if people wishing to submit articles for The Fossil Collector had access to a computer and word processing program they could send their articles to me on disk. I have received a few enquires since the last bulletin as to which programs I use and which programs I am able to read. With the production of The Fossil Collector I use both WordPerfect for Windows version 6.0a and Microsoft Publisher version 2.0. WordPerfect 6.0a will read and convert articles produced using MS Word versions 4.0, 5.0 and 5.5, MS Word for Windows versions 1.0, 1.1, 1.1a, 2.0, 2.0a, 2.0b and 2.0c, Office Write versions 6.0, 6.1, 6.11 and 6.2, Professional Write versions 1.0 and 2.2, Quattro Pro for Windows versions 1.0 and 5.0, Volkswriter 4, Windows Write, WordPerfect versions 4.2, 5.0, 5.1 and 5.2, Wordstar 2000 versions 1, 2 and 3, Wordstar versions 3.3, 3.31, 3.4, 4.0, 5.0, 5.5, 6.0, and 7.0. Articles converted using WordPerfect 6.0a can then be imported directly into Microsoft Publisher. If the author of an article has access to a scanner, any drawings or diagrams that are included with the article can be scanned to file using either BMP, GIF, TIFF or WPG formats. This will then allow me to import the graphic directly into the article, thus saving time at the printing stage. Hopefully the above information will make things a little easier for potential authors.

Whilst on the subject of computers, I can also be reached by E-mail. For those who have access to the Internet my mail address is 100237.1545@compuserve.com and those who are members of CompuServe my address is 100237,1545. If anyone subscribing to Internet finds any interesting news articles, please send them to me for possible inclusion to the In The News section of The Fossil Collector.

Finally, I would like to thank Anne Kemp, Frank Holmes and Ian Sobbe for their contributions which made Bulletin 45 possible, thankyou. I only hope that the kind submission of material continues to happen. The deadline for the next issue of The Fossil Collector is November 24th.

FINANCES

Income and expenditure for the sixteen months, 1st March, 1994 to 30th June, 1995. The previous twelve months income and expenditure (1st March, 1993 to 28th February, 1994) is shown in brackets. While the two periods are of different duration, due to the change in the Association's financial year, apart from the effect the change has had on the month during which the majority of subscriptions are received - and consequently the period, the accounts are basically comparable, each period covering the issue of three bulletins.

INCOME			EXPENDITURE		
Subscriptions			Postage	866.95	(873.50)
current	867.50	(1036.00)	Printing	558.41	(602.38)
advance	173.71	(808.62)	Photocopies,		
Donations	15.50	(23.00)	photo's, bromides	117.60	(105.60)
Advertising	38.00	(40.00)	Stationary	92.72	(173.60)
Bank Interest	38.44	(53.12)	Sundries	102.20	(119.65)
Bulletin Sales	56.75	(151.66)	Secretarial expenses	47.40	(22.70)
			Donation (Save Eric)	—	(250.00)
			State/Fed. tax	8.32	(6.20)
	$1189.90	(2112.40)		$1793.60	(2153.63)

Balance at 30th June, 1995.

Brought forward from 1993/1994		$2070.63
Add income	1994/1995	$1189.90
		$3260.53
Less expenditure	1994/1995	$1793.60
		$1466.93

When the 1994/95 income is adjusted to include subscriptions paid in 1992/93, and 1993/94 ($760.00) and to exclude 1995/96 subscriptions ($173.71), income for the financial period 1994/95 exceeded expenditure by $18.59 compared with a deficit of $94.02 for the previous year. After deducting total advance subscriptions of $173.71 from the balance in hand at 30th June, 1995, we are left with a **NET RESERVE OF $1293.22** ($1229.01).

Assets are valued at approx $800.00, which includes part ownership of a Word Processor [50%], stationary, staplers and back issues of bulletins. At 30th June, 1995, liabilities were limited to sundry editorial expenses associated with Bulletin 45.

DINOSAURS IN THE LAND OF LANTERNS
THE SIXTH MESOZOIC TERRESTRIAL ECOSYSTEMS SYMPOSIUM

Report by Ralph Molnar. Queensland Museum, Brisbane. Queensland.

The recently held sixth symposium on Mesozoic Terrestrial Ecosystems and Biotas in China, consisted of the conference itself, held in Beijing, and two field excursions. I attended the conference and only the first field excursion, to southwestern China.

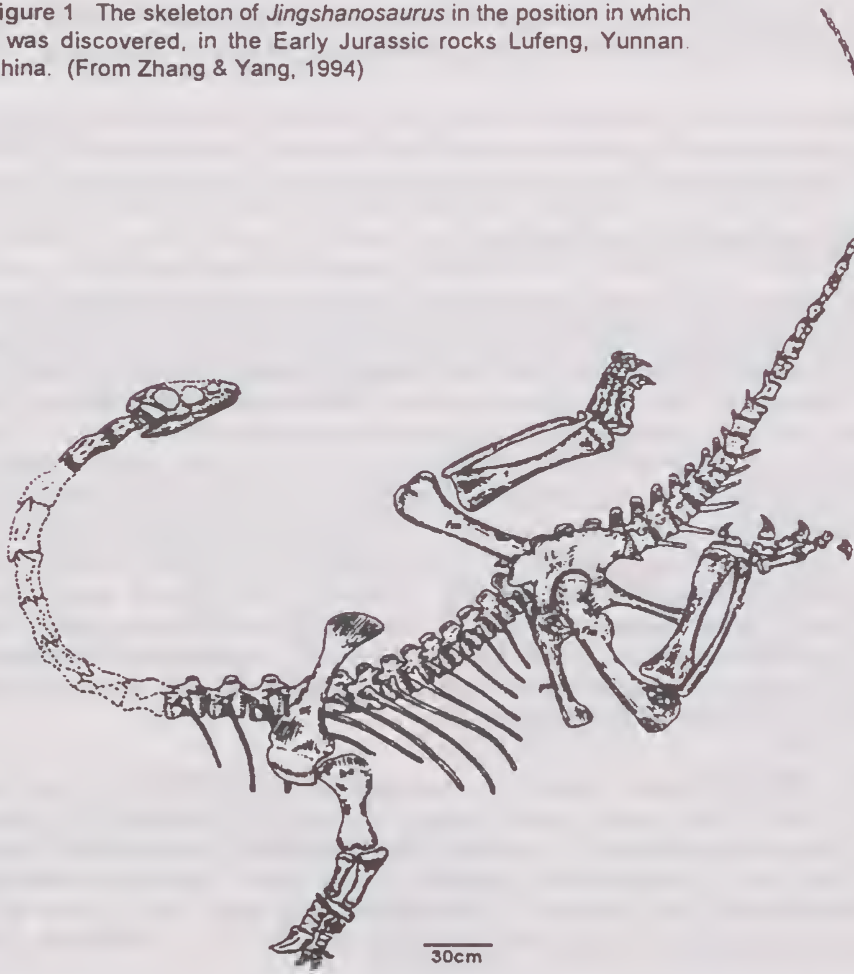
SOUTHWESTERN CHINA EXCURSION

The first half of the excursion was in Yunnan, renowned for the Early Jurassic faunas found in the Lufeng region. During the Second World War, the Japanese mainland army drove through northeastern China and the capital was removed to Kunming in Yunnan. Along with the government went the Palaeontological Institute. Thus Young, Bien and their fellow scientists explored and collected in this region. There had been rumours of human fossils here and extensive prospecting was undertaken. Although human fossils were eventually found, the most obvious were fossils found along the Burma road in the Lufeng Basin. Yunnan is a precipitously mountainous region with the ranges separated by flat - floored basins, orientated roughly north - south. Several of these (Lufeng, Anning, Yimen and the central basin around Kunming) have yielded dinosaurian fossils. The Lufeng Basin was the first in which these were discovered and it became an internationally known locality for dinosaurs, crocodylians, turtles, synapsids and mammals. Originally thought to be Late Triassic in age, it is now recognised as Early Jurassic.

The Lufeng County Museum included a large hall with four mounted prosauropod skeletons - three of them being plaster replicas of material held elsewhere - as well as photos and individual bones. The prosauropods included *Lufengosaurus huenei* (Young, 1940) and *Lufengosaurus magnus* (Young, 1940), as well as the large, recently described *Jingshanosaurus xinwaensis* (Zhang & Yang, 1994), found on the grounds of a local temple at Golden Mountain (Jing Shan).

The localities we visited were at about 2000 metres altitude (and on the basin floor!) and the weather was hot (c. 40ºC), humid and sometimes rainy. Across the basin floor , in addition to the county seat of Lufeng, were scattered small villages and rice paddies. The hills were left uncultivated and these comprised the outcrops of the Lower Lufeng Formation. There was a noted absence of wildlife , with few kinds of birds or even insects. The Chinese palaeontologists, who hadn't visited the sites for some years, commented that the reforestation project of the local peasants had succeeded to the extent that many of the previously barren outcrops were now covered over with trees, many of them eucalypts. At two localities, near the village of Dawa, the locals had constructed small cottages for prosauropod skeletons found there, these had been cleared of rock and left articulated in situ in the cottage floor.

Figure 1 The skeleton of *Jingshanosaurus* in the position in which it was discovered, in the Early Jurassic rocks Lufeng, Yunnan. China. (From Zhang & Yang, 1994)



The field excursion, of about twenty people, quickly found that fossils were by no means scarce. Teeth (probably from theropods), and prosauropod bones were easily spotted with vertebrae, a femur, phalanges and a large first metacarpal being found. Whilst hiking through one of the villages a local peasant pointed out some dinosaur vertebrae which had been found by some local peasants and carefully stored by them. The locals, both peasants and townsfolk, were obviously proud of the fossils and as the construction of the local museum and cottages for the skeletons showed, willing to put in considerable effort to take care of them. One of them, a Mr. Wang, was a keen collector - probably having the highest score in finding fossils that day - and had gone so far as to teach himself English to be able to read works in palaeontology.

Not all of our time was spent in the Mesozoic, however. We also visited a Miocene hominoid site, where *Ramapithecus* and *Sivapithecus* material, including skulls, had been found. Jean Jaeger pointed out that the fossils from here indicated a forest habitat, very similar to those of Europe. This suggested that during the Miocene an unbroken forest extended from the Atlantic east to at least central China.

Due north of Yunnan is the province of Sichuan. The region is a large, roughly square basin, with an unbroken settlement for over two millenia. Surrounded by high mountains, it lies directly east of Tibet. It is noted for agricultural production and sites of religious, especially Buddhist, significance. Chengdu, the capital, is a gracious city of broad, tree lined boulevards and an air of cultural and economic prosperity.

East of Chengdu the basin opens out to the agricultural land, with scattered steep, rocky hills and mountains. Here the first dinosaurian fossil was found by G. D. Louderback, an American geologist, in 1929. Further exploration by Chinese from Beijing followed the movement of the government during World War II. However, both groups missed the major localities, which were discovered in the Zigong region in the early 1970's, and which have continued at irregular intervals since. Zigong, known also for its China Lantern Museum, is in salt mining country so the locals have an interest in things geological. And, like their neighbours to the south, they have taken to their local dinosaurs.

Like Yunnan, Sichuan is hot and humid, and hence supports extensive vegetation, so the fossils are often found in excavations. The rocks are Jurassic in age and have yielded a large variety of dinosaurs and turtles, in addition to mammal-like reptiles, pterosaurs and ornithopods. The first Jurassic temnospondyl amphibian (*Sinobrachyops*) from outside Australia was found here. The Zigong Dinosaur Museum was constructed over a bed of abundant (mainly) sauropod bones, still in place. In addition, it houses skeletons of the large sauropod *Omeisaurus* (Young, 1939) - heads lifted on swan-like necks some 8-9 metres above the floor - stegosaurs and other reptiles. The skeleton, partly reconstructed, of an immature omeisaur about six metres long emphasized the great size of the adults. Although many of the sauropods are large, twenty metres or more in length, the carnivores, such as *Gasosaurus* (Dong & Tang, 1985), are only about four metres long, markedly smaller than some of their North American or European contemporaries.

In the Sichuan Basin, fossiliferous continental rocks comprise almost the entire Jurassic period. Here the evolution of a dinosaurian fauna can be traced in a single region. Between the Early and Middle Jurassic there is a major turnover, with the prosauropods replaced by the sauropods. There is no such obvious change during the later Jurassic evolution, however the more primitive sauropods, such as

Shunosaurus (Dong, 1983), seem to disappear and leave those, like *Omeisaurus*, with very long, slender necks. In the Late Jurassic a variety of stegosaurs are seen, as opposed to one in the Middle Jurassic, and small predators were represented by the strange land dwelling ziphodont crocodylian *Hsisosuchus* (Yang & Zhao, 1953), which was less than two metres long. Fossils of araucarians to twenty metres high have been found, these probably looked very much like the modern Norfolk Island Pine or Bunya Pine when alive.

Figure 2. The skeletons of *Omeisaurus tienfuensis*, representing the size of the adult and juvenile on display in the dinosaur museum at Zigong, Sichuan, China. The juvenile skeleton is not as complete as it is represented here.

BEIJING CONFERENCE

The most exciting issue of a conference with many significant and exciting presentations was doubtless the new Jurassic bird from Liaoning, northeastern China. *Confuciusornis sanctus* (Hou, Zhou, Guo & Zhang, 1995) is represented by two partial skeletons, both with complete skulls, and one with feathers in place along the hind limb. It is clearly distinct from *Archaeopteryx* (von Meyer, 1861). The skull has a has a large, deep beak and seemingly lacks teeth. It was suggested that a few small teeth may have been present, but this is not yet clear. The wings bore claws, somewhat larger than those of *Archaeopteryx*, and the humerus was strongly developed, with a large pneumatic foramen. The Chinese regard both *Confuciusornis* and *Archaeopteryx* as primitive enantiornithine birds, related to *Nanantius* (Molnar, 1986) from Queensland, and not as general ancestors of the birds as a whole. It is clear from *Confuciusornis* - with few or no teeth and the stronger humerus - that *Archaeopteryx* was not the latest word in avian evolution during the Late Jurassic. Thus birds must have had a longer ancestry than we know and if the Chinese are correct about the taxonomy of these two birds, possibly a considerably longer ancestry than we know.

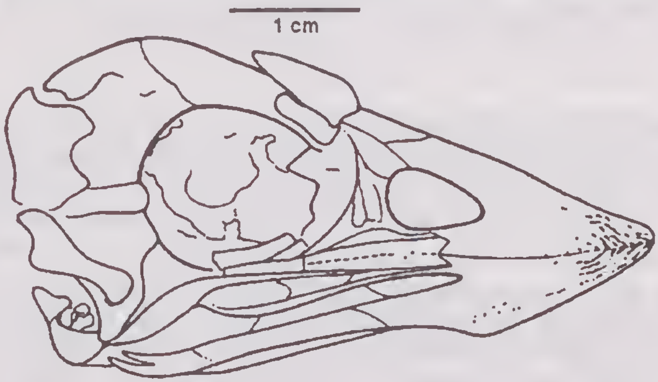


Figure 3. The skull of the Late Jurassic bird, *Confuciusornis sanctus*. This bird, from Liaoning in northwestern China, is approximately as old as *Archaeopteryx*.

In addition to *Confuciusornis*, several recently discovered birds from the Early Cretaceous of China were shown at the conference. These included several skeletons and partial skeletons, and will provide new information on the origin and early evolution of birds for a long time to come. The discovery has already stimulated Larry Martin (University of Kansas) to propose an interesting new hypothesis for the origin of neornithines (modern birds). Taking into account that most early neornithine fossils represent shorebirds, perhaps like modern sandpipers or curlews, he suggested that early neornithines were shoreline or riverbank scavengers. A significant part of his idea was that these birds developed the ability to take off from a dead stop on a flat surface. To be able to do so, these early neornithines would have had to have been small. Even today, many large birds do not do this, as seen by the runs of albatross during take-off. Martin's hypothesis also accounts for the recent findings from bone histology that the early birds, particularly enantiornithines, may not have been warm blooded (i.e., tachymetabolic endotherms). He suggests that endothermy originated in the small proto-neornithines as they evolved the ability to take off from a flat surface.

Almost matching the excitement generated by the new birds was the announcement of the discovery of a complete, articulated skeleton of a symmetrodont, one of the very few for any Mesozoic mammal.

Quite a number of issues of evolutionary and functional significance were discussed. David Unwin reported on his search for hair in pterosaurs. He, with his wife Natalie Bakhurina, had discovered that the alleged hair of the 'hairy pterosaur' *Sordes* (Sharov, 1971) was in fact fibrous material from the wing membranes. Unwin reported that in addition to the wing fibres, at least four genera of pterosaurs, including the Chinese *Zhejiangopterus* (Cai & Wei, 1994), did have a hairy covering. Paul Barret and Paul Upchurch reported on the functioning of sauropod necks. They quite reasonably concluded that different sauropods used their necks for different functions - some had long necks useful for feeding high in trees, others, like *Dicraeosaurus* (Janensch), had shorter necks and probably fed from the ground or bushes.

Several papers were given on the zoogeographical relationships of dinosaur faunas. Jean Le Leouff argued that the Cretaceous European fauna was an indigenous fauna that evolved in isolation for some time, as I, also, argued for the Australian Cretaceous dinosaurs. The Chinese, on the other hand, argued that their native dinosaurs probably didn't evolve in as much isolation as had previously been thought. I also pointed out the similarity in feeding mechanisms of *Muttaburrasaurus* (Bartholomai & Molnar, 1981) and the ceratopsian dinosaurs. Both seemingly had cutting, rather than grinding, teeth and enlarged, powerful jaw muscles. New fossils were also reported, including Early Cretaceous ornithomimids from Thailand, the skull of a basal hadrosaur from Texas and a champsosaur skeleton from Japan. Eric Buffetaut reported the recent discovery of fossils of a bird the size of an ostrich from the latest Cretaceous beds of the Riviera in France, a much larger bird that has previously been reported from anywhere in the Mesozoic. The American Museum team had just returned from Mongolia and gave some of their preliminary results. They reported having found twenty theropod skeletons in a single day at the beginning of their work, as well as a skull of the controversial *Mononykus* (Perle, Novell, Chiappe & Clarke, 1993) which lacked the postorbital bar, a feature otherwise only found in birds, which they claim *Mononykus* is. They also located another skeleton of *Oviraptor* (Osborn, 1924) sitting on a nest of eggs.

Bill Clemens reported new results on the Late Cretaceous mammals from the USA. It appears that the famous Cretaceous mammals from Bug Creek were not Cretaceous, although this is not totally clear yet. They may actually come from the overlying Palaeocene beds. His work also confirmed that marsupials did almost become extinct, along with the dinosaurs. Seventy five percent of the marsupials in Montana died out at the end of the Cretaceous.

Unfortunately the limitations of my memory prevent me from mentioning all of the papers presented but, both the conference and field excursion were stimulating.

REFERENCE

Sun, A. and Wang, Y., 1995. *Sixth Symposium on Mesozoic Terrestrial Ecosystems and Biota Short Papers*. China Ocean Press: Beijing, 250 pp.

NEWLY DESCRIBED EARLY SILURIAN TRILOBITES FROM NORTH QUEENSLAND

David J Holloway Museum of Victoria. Melbourne. Victoria.

A paper recently published in the *Memoirs of the Museum of Victoria* (Holloway, 1994) describes a trilobite fauna of Early Silurian age from the vicinity of the Broken River, about 200 km west of Townsville in north Queensland. The trilobites occur in siltstones belonging to the Broken River Province, a roughly wedge shaped region of Palaeozoic sedimentary and volcanic rocks covering an area of approximately 15,000 km² (Fig. 1). The term 'province' is used here to refer to a geological domain characterised by broad similarities in rock types, tectonic structure and geological history

The Broken River Province is bounded to the north - west and south by major fault systems separating it from older, mainly Late Precambrian to Early Palaeozoic crystalline rocks of the Georgetown and Lolworth - Ravenswood provinces. To the east the Broken River sequences are covered by younger Late Palaeozoic igneous rocks

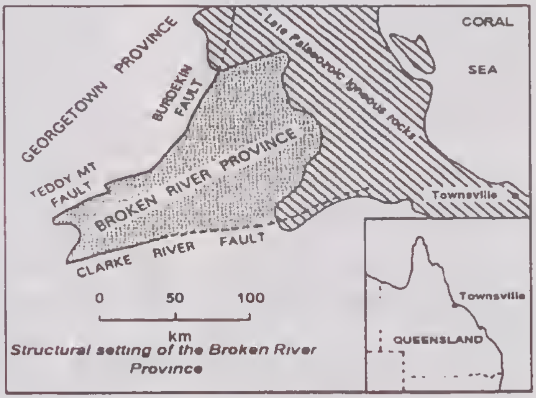


Figure 1

The Broken River sequences, ranging in age from Early Ordovician to Carboniferous, include turbiditic sandstones, mudstones and conglomerates commonly associated with submarine volcanics, sandstones and richly fossiliferous limestones deposited on a shallow marine shelf, occurring mainly in the Upper Silurian to Middle Devonian part of the sequence, and fresh water to shallow marine sandstones and mudstones in the uppermost part of the sequence Rich fossil faunas occur in some of the strata, especially the limestones, which are dominated by corals and stromatoporoids (calcareous sponges) However much of the fossil fauna is still poorly documented.

The earliest geological investigations in the Broken River Province were carried out in the 1870s by Richard Daintree and in the late 1880s by Robert Logan Jack, Government Geologist for Queensland A few other surveys were conducted intermittently during the years up to 1956, when the first systematic regional geological mapping was commenced by the Geological Survey of Queensland and the Bureau of Mineral Resources (now the Australian Geological Survey

Organisation). The results of that mapping were published by White et. al. (1965) More recently, detailed studies of the stratigraphy, sedimentology and structural geology of the sequences, as well as aspects of the palaeontology (in particular the coral and conodont faunas) have been undertaken, mainly by the Geological Survey of Queensland and by staff and students of the University of Queensland, James Cook University and Macquarie University. Some results of this work are summarised in Withnall and Lang (1993).

The trilobites described by Holloway (1994) come from the Poley Cow Formation, which crops out in the southern part of the Broken River Province. Named after Poley Cow Creek, a tributary of the Broken River, the formation consists of up to 550m of siltstones, mudstones and conglomerates unconformably overlying Ordovician volcanics, sandstones and mudstones. Fossils are not common in the Poley Cow Formation, but a few scattered localities have yielded shelly faunas as well as graptolites indicative of an Early Silurian (Llandovery) age. Apart from trilobites, the shelly fauna of the Poley Cow Formation includes brachiopods, bivalves, gastropods, nautiloids, ostracodes and abundant disarticulate crinoid remains, all preserved as internal and external moulds in thinly bedded, fine micaceous siltstones. The trilobites are disarticulated and commonly broken, indicating that they are not preserved where they originally lived but have been transported or reworked by water currents before deposition. All of the faunal elements are represented by specimens of relatively small size, suggesting that sorting by current action may also have occurred. This evidence is consistent with conclusions based on sedimentological studies that the Poley Cow Formation was deposited in a shallow, off shore marine shelf environment affected by storm and wave activity.

The trilobite fauna of the Poley Cow Formation is assigned to the following fifteen genera, each represented by a single species (see also Figs 2, 3.).

Family Styginidae (= Scutelluidae)
Kosovopeltis

Family Proetidae
Proetus
Warburgella?

Family Cheiruridae
Youngia
Sphaerexochus
Sphaerocoryphe

Family Odontopleuridae
Gaotania
Ceratocephala

Family Scharyiidae
Scharyia

Family Aulacopleuridae
Maurotarion
Otarion

Family Encrinuridae
Prostrix
Batocara
Coronocephalus?

Family Calymenidae
Gravicalymene?

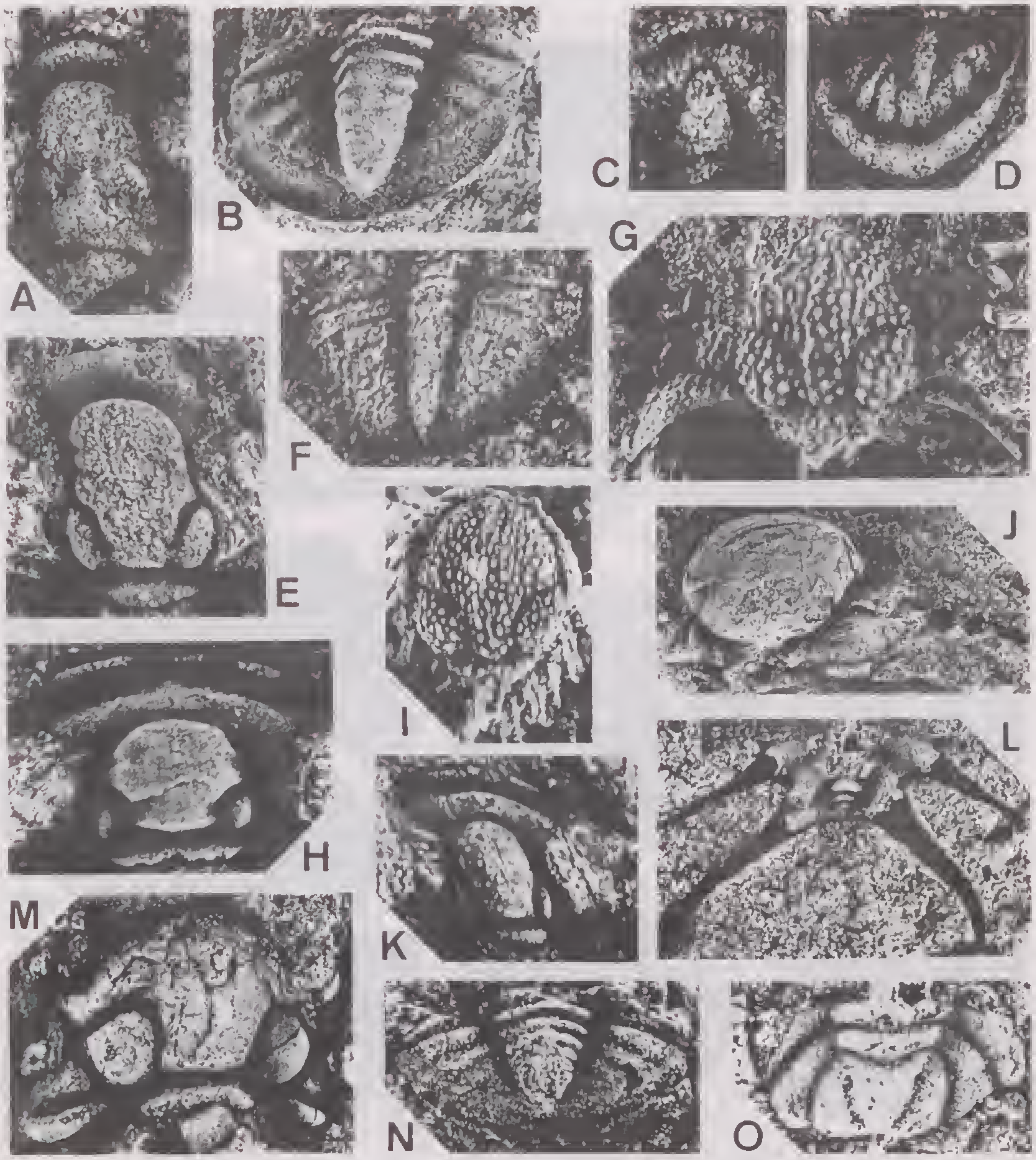


Figure 2. A, B, *Proetus* sp., cranidium, X 10, and pygidium, X 7 C, D, *Scharyia* sp., cranidium and pygidium, X 12. E, F, *Warburgella*? sp., cranidium, X 8, and pygidium, X 9. G, I, *Youngia* sp., cranidia, X 6 and X 5. H, *Maurotarion* sp., cranidium, X 6.5. J, L, *Sphaerocoryphe* sp., cranidium, X 4, and pygidium, X 5. K, *Otarion* sp., cranidium, X 10. M, O, *Sphaerexochus* sp., cranidium, X 5.5, and pygidium, X 9. N, Aulacopleuridae indet., pygidium (belonging to either *Maurotarion* or *Otarion*), X 9. All specimens are in the Museum of Victoria collections.

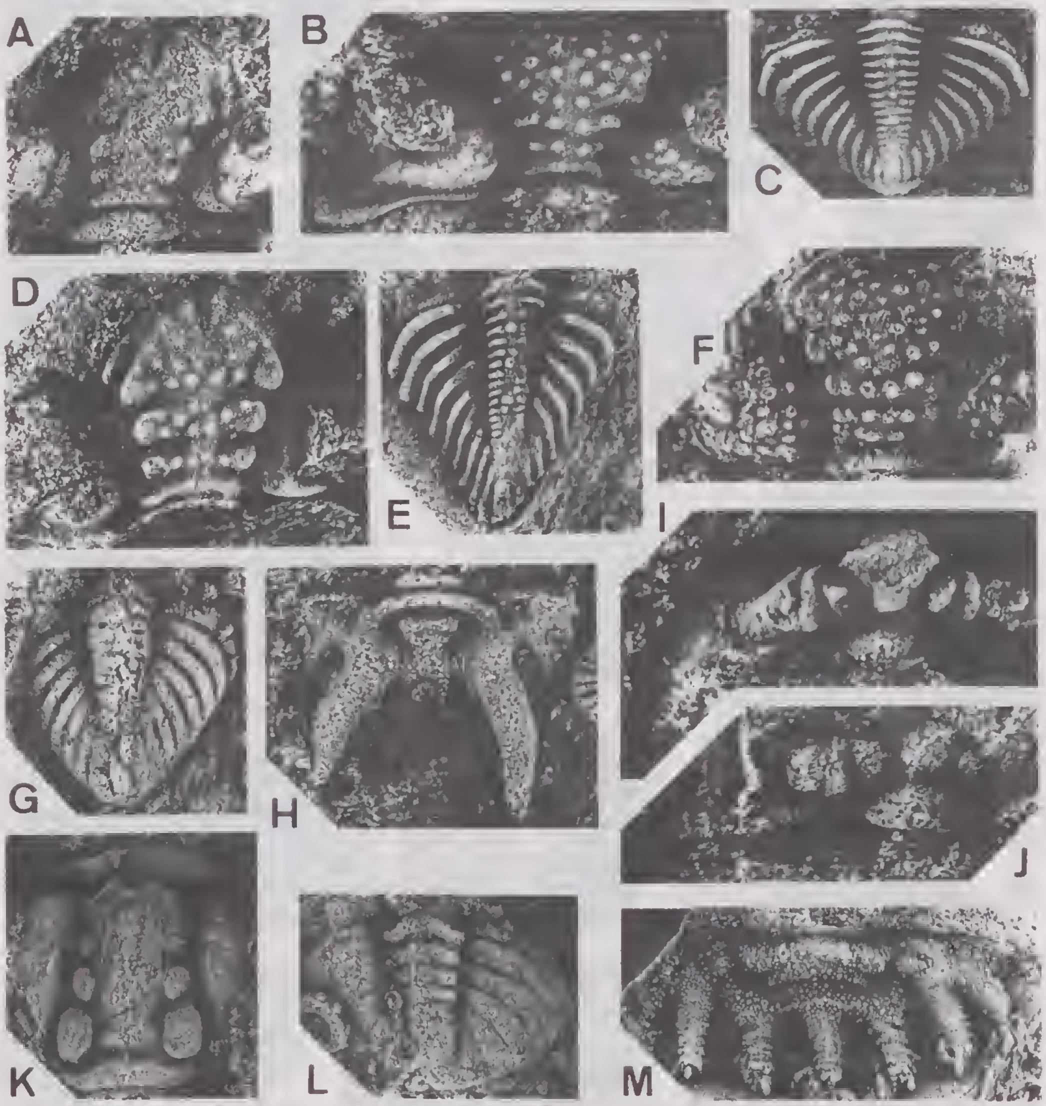


Figure 3. A, D, G, *Prostrix amnicola*, cranidia, × 7 and × 4.5, and pygidium, × 4. B, E, *Batocara fritillum*, cranidium, × 5.5, and pygidium, × 6. C, F, *Coronocephalus*? aff *urbis*, pygidium, × 6, and cranidium, × 5. H, I, J, *Gaotania bimusa*, pygidium, × 8, and counterparts of cephalon, × 8.5. K, L, *Gravicalymene*? *vaccina*, cranidium, × 3.5, and pygidium, × 3. M, *Ceratocephala* sp., pygidium, × 3. All specimens are in the Museum of Victoria collections.

One genus (*Prostrix*) and four species (*Prostrix amnicola, Batocara fritillum, Gravicalymene? vaccina, Gaotania bimusa*) are newly named; however, because of the indifferent quality of the preservation, most of the trilobites are not assigned to named species. *Youngia* and *Gaotania* are recorded from Australia for the first time, the former previously being recorded from the Lower Silurian of Europe and North America, and the latter from the Lower Silurian of China. In this paper, most Australian species previously assigned to *Encrinurus* are transferred to *Batocara*, which is regarded as a senior synonym to *Pacificurus* (Ramsköld, 1986).

A small trilobite fauna previously described from the Broken River Province by Lane and Thomas (1978) came from the Early Silurian Quinton Formation, a lateral equivalent of the Poley Cow Formation some 25km north of the Broken River. This fauna was dominated by a smooth styginid, *Rhaxeros*, and also included fragmentary remains of the cheirurid *Sphaerexochus*, an encrinurid, a possible warburgelline proetid and an indeterminate calymenid. Smooth styginids such as *Rhaxeros* have not been found in the Poley Cow Formation, while the other trilobite material recorded by Lane and Thomas is mostly inadequate for useful comparison with forms from the Poley Cow Formation.

The only other Early Silurian trilobite faunas previously described from Australia are those of the "*Illaenus*" band in the Heathcote district of Victoria (Öpik, 1953); the Richea Siltstone in south eastern Tasmania (Holloway and Sandford, 1993); and the Rosyth Limestone in the Orange district of New South Wales (Fletcher, 1950). The first two of these faunas are very different from that of the Poley Cow Formation and the third may be slightly younger in age than Early Silurian. The trilobite assemblage of the "*Illaenus*" band is dominated by the smooth styginid *Thomastus* together with dalmanitids and the phacopid *Ananaspis*, all of which are absent from the Poley Cow Formation. The Richea Siltstone fauna includes *Decoroproetus*, *Latiproetus*?, *Trimerus*, *Acernaspis*, *Dalmanites*, *Anacaenaspis*, *Dicranurus*, *Maurotarion* and *Gravicalymene*, only the last two occurring also in the Poley Cow Formation. The Rosyth Limestone contains *Ananaspis*, *Trochurus*, *Batocara* and *Youngia*, although the last was not recorded by Fletcher (1950); *Batocara* and *Youngia* are shared with the Poley Cow Formation.

REFERENCES

Fletcher, H. O., 1950. Trilobites from the Silurian of New South Wales. *Records of the Australian Museum* 22: 220-233.

Holloway, D. J., 1994. Early Silurian trilobites from the Broken River area, north Queensland. *Memoirs of the Museum of Victoria* 54: 243-269.

Holloway, D. J. and Sandford, A., 1993. An Early Silurian trilobite fauna from Tasmania. *Memoirs of the Association of Australasian Palaeontologists* 15: 85-102.

Lane, P. D. and Thomas, A. T., 1978. Silurian trilobites from NE Queensland and the classification of effaced trilobites. *Geological Magazine* 115: 351-358.

Öpik, A. A., 1953. Lower Silurian fossils from the "Illaenus Band" Heathcote, Victoria. *Geological Survey of Victoria Memoir* 19: 1-42, pls 1-13.

REFERENCES cont

Ramsköld, L., 1986. *Pacificurus*, new name for *Australurus* Ramsköld (not Jell & Duncan). *Geologiska Föreningens i Stockholm Förhandlingar* 108: 308.

White, D. A., 1965. The geology of the Georgetown/Clarke River area, Queensland *Bureau of Mineral Resources, Geology and Geophysics Bulletin* 71: 1-165, pls 1-8.

Withnall, I. W. and Lang, S. C. (eds), 1993. Geology of the Broken River Province, North Queensland. (*Queensland Geology* No. 4), Department of Minerals & Energy, Queensland, Brisbane, 292 p.

THE FOSSIL EXCHANGE

Juerg Wegmueller, Talackerstr. 71, CH-3604 Thun, Switzerland. Juerg is an amateur collector interested in purchasing or exchanging fossil (or living) chondrichthyes remains (sharks, rays and chimaeras). He is particularly interested in fossils from the Miocene Epoch.

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.

BOOKS AND BOOK REVIEWS

CALIBRATING THE AUSTRALIAN PHANEROZOIC TIMESCALE. Available from, AGSO Sales Centre, GPO Box 378, Canberra, ACT 2601, Australia. Telephone (06) 249 9519/9642.

Correlation charts and explanatory notes published in the *Australian Phanerozoic Timescales subseries* that AGSO (then the Bureau of Mineral Resources, Geology and Geophysics) published in its *Record* series (numbers 1989/31 to 1989/40 inclusive are being progressively revised in the light of recent significant information.

The revised charts have been compiled mostly by palaeontologists of AGSO's 'Timescales calibration and development' project from data both published in the specialist literature and recorded from continuing boistratigraphical research. Like the previous charts, they integrate zonal schemes based on different groups of key fossils and isotopic and magnetostratigraphic data; where possible, they are related to sea level curves. Recently acquired isotopic ages determined from a sensitive resolution ion microphone (SHRIMP) have facilitated significant revision applied to the timescales of some systems, notably the Cambrian, Ordovician, Carboniferous and Permian. Further, a redefinition of the base of the Cambrian System by the International Union of Geological Systems, Commission on Stratigraphy, at about 545 million years old has led to a shortening of the Phanerozoic timescale by 25 million years.

AGSO scientists prepared the original charts and notes for each system as the foundation for AGSO's *Palaeogeographic Atlas of Australia* series and 'Phanerozoic history of Australia' project, which are respectively sponsored by AMIRA (the Australian Mineral Industries Research Association) and funded by APIRA (the Petroleum Division of AMIRA). Since they were revised, they have formed the basis for developing a composite AGSO Phanerozoic timescale chart and a condensed single volume summary, currently in press.

AGSO has released the first five Australian Phanerozoic timescales biostratigraphic charts and explanatory notes (second series) for the Cambrian (by John Shergold; *Record 1995/30*), Devonian (by Gavin Young; *Record 1995/33*), Carboniferous (by Peter Jones; *Record 1995/34*), Jurassic (by Dennis Burger; *Record 1995/37*) and Cretaceous (also by Dennis Burger; *Record 1995/38*). They each cost $30.00 plus postage and handling charges of $5.00 (in Australia) or $15.00 (overseas); reduced postage and handling charges apply to orders of two or more of these *Records*.

Information supplied by Frank Holmes

PREHISTORIC LIFE: THE RISE OF THE VERTEBRATES. by David Norman, illustrations by John Sibbick. 1994. Boxtree, ISBN 1 85283 4005, 247pp., hardback. Price £19.00. If people wish to obtain this book, I would suggest that as the publisher and ISBN are available, try a local book dealer to see if it can be ordered. (Ed).

In discussions with David Norman on matters palaeontological, I sometimes get the impression that he would like to move away from the popularization of the science, in which he has been to some extent involved at times. The justification for him staying where he is, at least for part of the time, is nowhere better seen than in this splendid book. The illustrations are dramatic, whether photographs or otherwise; and there are plenty of 'serious' textfigures. In several instances the illustrations are bled to the edge of the page - as in *Marella* and *Acanthortega gunnari* - and I am certain that increases the impact to the viewer casually turning the page on initial inspection. In addition it helps one study the illustrations at leisure without the distractions of margins and marginal text. I suppose one could carry this sort of thing to extremes, but there is room for more of it in the book. I think *Prehistoric Life* is more than just a popularization of the science; it is a really good browse or a really good read, whichever you like. The author has been at pains, clearly, to write a lively text, yet has retained scientific precision in his generalizations. I think that is what defines a real expert: deep knowledge, and the ability to condense it with accuracy.

This book is about the rise of the vertebrates, but the author takes a long run at the bar, and we do not reach fish until page 68, and the land until page 85. Before that he scene-sets by discussing the origin of the Universe and the beginnings of life (in chapters 1 & 2). This he follows with a charming and most enjoyable account of the Cambrian environments and life; seen in illustrations of this kind, those weird Cambrian beasties do look as bizarre as the guys who work on them, which is appropriate, I suppose. The teeming seas (Ch. 4) deals with other invertebrates and the beginning of the fishy world.

The remaining six chapters deal with his main theme, and it is impossible not to get excited at his rendering of the earliest tetrapods and the origin of reptiles. He then deals with the period of dominance of the reptiles, with a special chapter on dinosaurs and birds. This last is not out of proportion at all, and is followed by the rise of mammals (Ch. 9), a quite excellent chapter. Lastly we have the rise of the primates. At the end are chapter by chapter further reading lists and an index.

This is a quality book for any intelligent reader or trained palaeontologist, and I have very few complaints. I was slightly disappointed by the misuse of some stratigraphical terms which seems unnecessary these days. Last of all, I had a look at the small section on graptolites: I think it is the worst brief account I have ever read, and that is saying something. When you consider that at the time the author wrote this tome there were at least three graptolite workers in the building with him, such errors are really inexcusable. It is, however, a matter of small import with respect to the rise of the vertebrates.

Summary: a top class book, superb value for money and highly useful at a range of educational levels.

Reviewed by R. B. Rickards, University of Cambridge.
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IN THE NEWS

New South American Theropod Dinosaur.

Recently, on the television news, mention was made of the discovery of a new theropod dinosaur by Ruldolfo Coria from the Cretaceous deposits of Patagonia in Argentina, South America. The dinosaur, named *Giganotosaurus*, was large, very large. With a length of about 12 metres, a weight of 8 plus tonnes and teeth between 15 and 22 centimetres long, *Giganotosaurus* was around the same size as *Tyrannosaurus rex*. About 75% of the skeleton was recovered and the remains are

Artistic impression of *Tyrannosaurus rex*.

in rocks that are 30 million years older than the oldest rocks *T. rex* has been recovered from. This part of the world must truely have been a land of the giants during the Cretaceous as not only does it now boast a large theropod dinosaur but can also lay claim to having one of the largest sauropod dinosaurs, *Argentinosaurus*, which was perhaps 40 metres long and weighed as much as 200 tonnes.

Arctic Fossils may Force Evolutionary Rethink.

Well preserved fossil animals discovered in 540 million year old rocks, on the northernmost tip of Greenland may force a rethink about the evolution of invertebrates.

According to two British palaeontologists, the fossils show that a group of animals called the halkieriids, which lived during the Cambrian period, are the ancestors of three separate groups of living invertebrates: the molluscs, the annelid worms and the brachiopods. If they are correct, the generally accepted view of invertebrate evolution - which places the brachiopods in a completely different branch of the invertebrate evolutionary tree to that of molluscs and annelids - might be wrong.

First discovered nearly thirty years ago, the only known halkieriid remains had been tiny scale like plates about a millimetre across, which made it impossible to work out how the creatures that grew them relate to other invertebrates.

The new fossils, which are whole, show that the halkieriids were extraordinary creatures. They had elongated bodies up to 80 millimetres long and 15 millimetres wide with a flat muscular "foot", similar to modem molluscs such as slugs and snails. The previously discovered tiny scales were carried on their back, and are similar to scales worn by a living group of molluscs called the sea hares. More interesting is the presence of two large shells on the new fossils, one over their head, the other over their tail. If these shells were brought together to enclose the entire animal, it would look like a modern brachiopod.

The link with annelids is via another fossil creature called *Wiwaxia*, which lived about 525 million years ago, during the middle Cambrian, a period which stretched from about 570 million years ago to 510 million years ago. *Wiwaxia*, which looked something like a hairbrush, had scales like those of the halkieriids, but they were more elongated. The *Wiwaxia* scales seem to be a halfway point between halkieriid scales and the bristles, or chaetae, carried by the polychaetes, a class of annelid worm that includes the modern lugworm.

The two British palaeontologists believe that the later halkieriids eventually evolved into the brachiopods, the earlier ones having given rise to the other two evolutionary lineages.

Summary of story in New Scientist No. 1972, page 18. April 8, 1995.

SMALL AUSTRALIAN TERTIARY ECHINOID RENAMED

Report by Frank Holmes

The clypeasteroid echinoid *Scutellinoides patella* (Tate 1891) was described from specimens collected in the Early Miocene Morgan Limestone exposed in cliffs along the Murray River; from the Early Miocene Gambier Limestone in the vicinity of Mount Gambier (South Australia) and from the Middle Miocene Muddy Creek Marl Member of the Port Cambell Limestone, near Hamilton (Victoria).

For almost a century *S. patella* has been recorded, often incorrectly, from over thirty localities in southem Australia, ranging in age from Late Eocene to late Pliocene.

Recently, Irwin (1995) has made a detailed comparison between the Early Miocene Morgan Limestone population and specimens, long attributed to *S. patella*, from the Zeally Limestone Member of the Puebla Formation cropping out in the cliffs southwest of Torquay, Victoria.

This comparison has revealed significant differences between the two populations requiring the renaming of specimens from the Early Miocene Zeally Limestone, *Orbispala occultoforma* Irwin, and placing the Morgan Limestone *S. patella* in a new family Scutellinoididae to accommodate the fact that this latter species has five genital pores, not four, as is the case with the family Fossulasteridae in which it was originally placed by Philip & Foster (1971).

The new species *Orbispala occultoforma* is small (usually about 10mm in length - maximum recorded 14.5mm), ovate to slightly pentagonal in outline, mildly conical adapically (upper surface), concave adorally (lower surface) and with a rounded ambitus (margin). The poorly defined ambulacral petals are broad, open distally and extend halfway to the ambitus. The ovoid shaped peristome (mouth) is situated slightly posterior of midway, while the laterally elliptical periproct (anus) is on the upper surface close to the ambitus. There are four genital pores but unlike other members of the family Fossulasteridae, in which *O. occultoforma* is placed, there is no marsupium in females.

Scutellinoides patella has a rounded and flattened ovoid to subdecagonal test (up to 25mm long) with mildly concave adoral surface and inflated ambitus. There are five genital pores but no ambulacral petals, the pore pairs being undifferentiated. The subcircular peristome, like that of *O. occultoforma*, is slightly posterior of midway and the laterally ovate periproct close to the ambitus on the upper surface. There is no marsupium in females.

Although the marsupiate genera of the Fossulasteridae (*Fossulaster* and *Willungaster*) were described by Philip & Foster in 1971 (Palaeontology 14: 666-695) there are without doubt new species of both Fossulasteridae and Scutellinoididae still to be described from the Tertiary of Australia. In particular, Irwin notes that specimens from the Muddy Creek Marl constitute a new, as yet undescribed, species of *Scutellinoides*.

REFERENCE

Irwin, R. P., 1995. New family and genus of Clypeasteroida (Echinoidea) from the Australian Tertiary. *Memoirs of the Association of Australasian Palaeontologists* 18: 189-198.

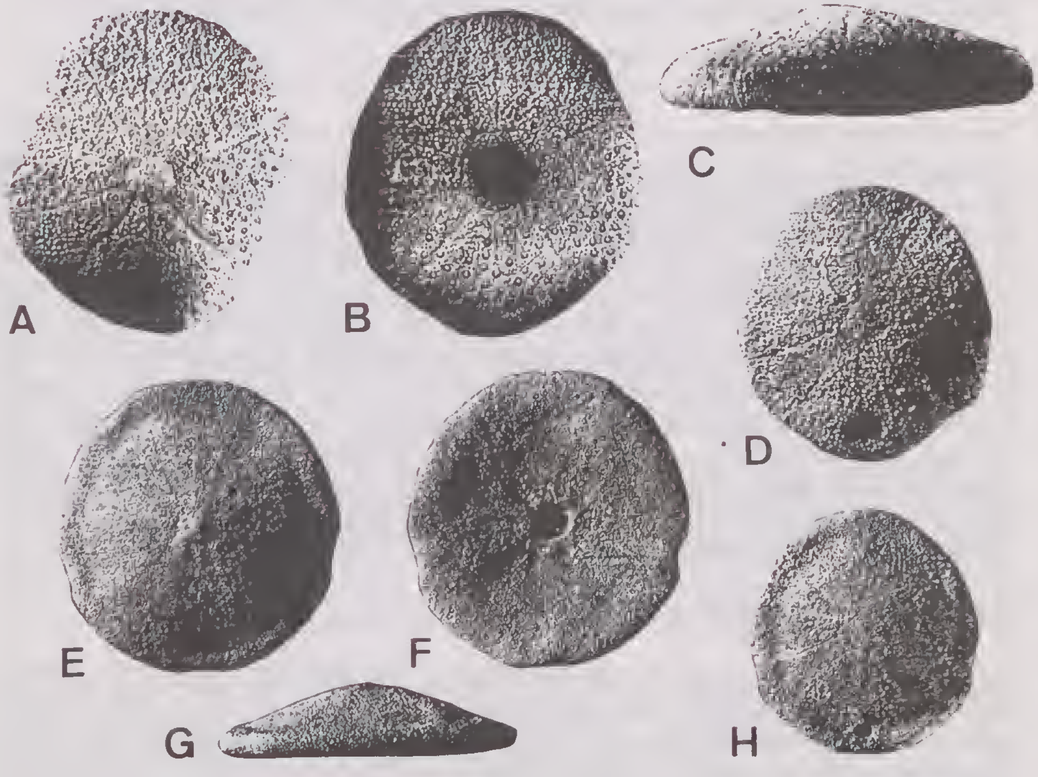

Figure 1. *Orbispala occultoforma* Irwin, 1995. A-C, holotype NMV P139064, adapical, adoral and lateral views X4.4; D, NMV P139068, adapical view X4.4. *Scutellinoides patella* (Tate, 1891). E-G, SAM P22067, adapical view X1.6. Photographs reproduced from Irwin (1995).

ANCIENT DNA

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The following article is reprinted from M.A.P.S. Digest (the official publication of the Mid-American Palaeontological Society), Volume 18, Number 2, February 1995, with the kind permission of the author.

With the recent release of the video Jurassic Park, the minds of fossil enthusiasts once again return to the thought of "could this really happen?" The original book by Michael Crichton was in fact based, in part, on actual scientific studies in which DNA was purified and studied from extinct organisms ranging from several hundred to 120 million years old. In this article I will attempt to explain the nature of DNA, what it can tell us about extinct creatures and how it is obtained from well preserved fossils.

WHAT IS DNA?

The best layman's explanation I have ever heard on the nature and role of DNA is in the first thirty minutes of the movie Jurassic Park. If you haven't seen the movie, read on. If you have seen Jurassic Park, feel free to skip a paragraph. The word DNA is an abbreviation for the chemical name, deoxyribonucleic acid. In essence, DNA is a long polymer found in all living cells and viruses. The chromosomes in our own cells are nothing but long coiled strands of DNA. If each chromosome in a single human cell was uncoiled and the DNA strands placed end to end they would stretch three feet. DNA is composed of seemingly random combinations of the repeating chemical subunits adenine, cytosine, guanine and thymine (A, C, G and T for short). In reality, the order of these subunits is not random and specifies an easily read code which we call the DNA sequence. Each chromosome has thousands of different coded messages organised in separate units called genes. The genes lead to the synthesis of a specific protein and determines whether a cell will be part of a plant or an animal. Think of DNA as a blueprint for life and you have the idea.

WHY STUDY DNA FROM EXTINCT ANIMALS?

Since the DNA in a cell determines the nature of the organism, it becomes obvious that DNA from one animal must have a different sequence of A, C, T and G's than DNA from a different animal. In fact, the theory of evolution predicts that DNA sequences change randomly across the eons of time resulting in the evolutionary changes observed in the fossil record. By studying DNA from ancient sources, the rate of evolution of one species to a new species can be directly measured as changes in the sequences of the DNA. Perhaps the most helpful reason to study ancient DNA is to help classify ancient creatures. DNA sequences isolated from a *Tyrannosaurus rex* bone (discussed below) would certainly end the debate as to the relationship of the dinosaur theropods to modern birds. Today there is concern over the loss of biodiversity. By examining DNA from extinct plants and animals it is theoretically possible to re-diversify present day life by the reintroduction of lost gene sequences. For example, certain proteins in exotic plants produce compounds with medicinal uses. Genes which make related, yet presently extinct, proteins could be isolated from ancient plants in amber and used to make new drugs by genetic engineering of modern plants.

DNA FROM EXTINCT PLANTS, BIRDS AND MAMMALS.

Scientific reports have been published detailing the isolation and partial characterisation of ancient DNA from many diverse sources. The first attempts involved the recovery of DNA from the hides and bones of recently extinct animals such as the Quagga and Tasmanian Tiger. Extending the technique by thousands of years, DNA has also been isolated from the Moa, a giant ground sloth, mammoths and a sabre toothed cat. The information from these studies was strictly phylogenetic, that is, it showed the relationship between these extinct animals and modern animals. Ancient DNA is obtained with relative ease from samples 20,000 to 40,000 years of age.

As DNA ages, it is normally degraded by extended contact with water. After the passage of millions of years, the probability of identifying useful DNA is nearly zero. Fortunately, under extraordinary conditions of fossilisation, a few specimens of plants, insects and animals have been discovered with sufficient DNA intact for study. Several laboratories have independently published chloroplast gene sequences isolated from plant specimens from the Miocene Clarkia deposit (17-20 million years old). This was surprising and still considered controversial since the plant material is fossilised in shale. Less controversial is the work published by the laboratories of Rob DeSalle and Raul Cano detailing the isolation and characterisation of DNA from amber entombed insects and plants. George and Roberta Poinar discovered that Dominican amber (20-40 million years old) acts as an excellent preservative, capable of preserving the tissue, individual cells and even nuclei of embedded insects. Extending these observations, the Poinars collaborated with Cano and isolated DNA from a Cretaceous (120 million year old) weevil in Lebanese amber. This accomplishment proved that DNA could be recovered from dinosaur age specimens.

It should be mentioned that the technique used to recover DNA from fossil specimens is extremely sensitive and very easily contaminated by as much as a single skin cell. For this reason palaeo DNA researchers have more than their fair share of critics. In my own laboratory at the Indiana University School of Medicine, we have been attempting to reproduce the results of Cano and Poinar. To date we have successfully recovered DNA from 30 million year old plant material preserved in Dominican amber, but have as yet failed to obtain DNA from insect inclusions. Part of the 18S rRNA gene DNA sequence obtained is shown on the next page, this is compared to the DNA of a present day plant (*Pisum sativum*) and human DNA.

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T A A T A C G T G C A A C A A A C C C C G A C T T C T G G A A G G G A
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T A A T A C G T G C A A C A A A C C C C G A C T T T T G G A A G G G A
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T A A T A C A T G C G A C G G G C G C T G A C C C C C T T C G C G G G
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Figure 1. Three DNA sequences from:- Top: 30 million year old plant.
Middle: Modern plant (*Pisum sativum*).
Bottom: Human.

DINOSAUR DNA.

The critical question in the minds of most people is, can DNA be found in the bones of dinosaurs? Two laboratories have answered this question as yes. Scott Woodward, working out of Brigham Young University, obtained Cretaceous aged bone fragments from a central Utah coal mine. The bones, presumed to be dinosaur, were found to be preserved as true bone and were not mineralised. Exhaustive experimentation yielded minute amounts of DNA with a sequence as closely related to mammals as to birds or reptiles. Woodward's findings were met cautiously since the DNA sequence was not related to the DNA's of present day animals thought to be distantly related to dinosaurs. Mary Schweitzer, a graduate student in Jack Horner's laboratory at the Museum of the Rockies, has been studying *T. rex* bones from the Hell Creek Formation. Amazingly, the bones of this particular animal were never mineralised and have retained the properties of natural bone. Schweitzer reported, at last years DinoFest in Indianapolis, that the blood canals in these *T. rex* bones contain spherical objects which look like blood cells. Jack Horner has gone so far as to make press releases stating that they have recovered DNA from the *T. rex* bones and that it is similar to bird DNA. However, until the scientific data is published, these conclusions cannot be properly evaluated. It will be extremely important to compare the DNA sequences found by the two laboratories to confirm their relatedness and their identity as true dinosaur DNA.

From our own experiments with dinosaur bone, we have confirmed the presence of DNA in a hadrosaur tibia obtained from the Cretaceous Judith River Formation. Like Horner's *T. rex*, this bone is poorly fossilised and appears to be normal bone. The question which must now be answered is whether the DNA in the bone is from the hadrosaur or from contaminating organisms, we hope to have an answer soon.

PROSPECTS FOR THE FUTURE

Molecular palaeontology has opened up avenues of research unthought of ten years ago. Can these studies lead to the resurrection of extinct life? By todays technology it is almost impossible to piece together 10 million small fragments of DNA into a large chromosome. However, with advances in technology and the discovery of better preserved material this could lead to extinct modern animal hybrids.