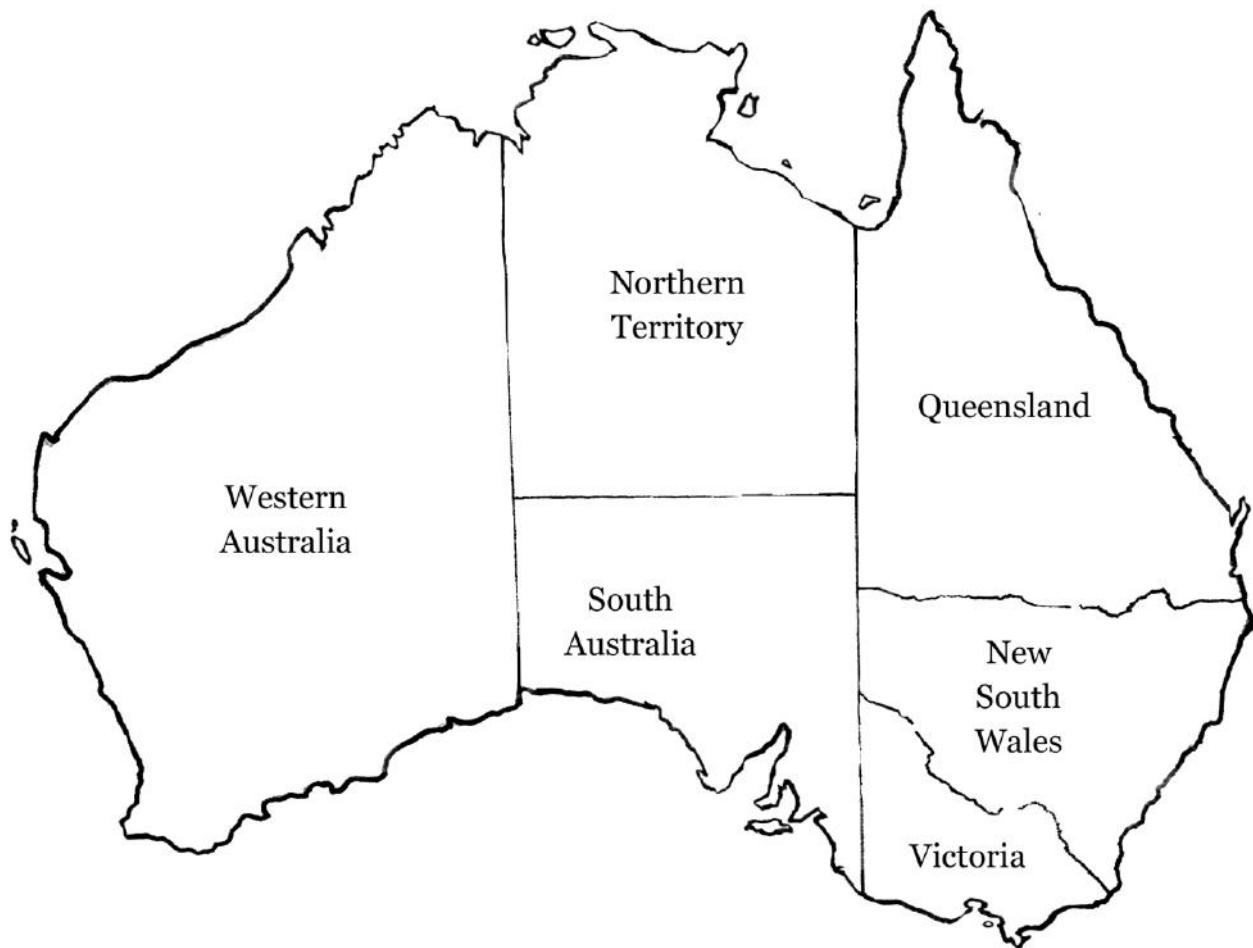


HISTORY OF THE AUSTRALIAN PALEONTOLOGICAL COLLECTIONS
In The Science Museum of Minnesota
by Bruce R. Erickson



MONOGRAPH VOLUME 13: PALEONTOLOGY

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MONOGRAPH
VOLUME 13: PALEONTOLOGY

The Science Museum of Minnesota
120 West Kellogg Blvd.
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Frontispiece: Two present-day Monotremes (egg-laying mammals), echidna (*Zaglossus*) (left) and platypus (*Ornithorhynchus*) (right) from early 1900 museum collections of SMM. Their similar counterparts are known from the Quaternary deposits of Australia.

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MONOGRAPH VOLUME 13: PALEONTOLOGY

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HISTORY OF THE AUSTRALIAN PALEONTOLOGICAL COLLECTIONS

In the SCIENCE MUSEUM OF MINNESOTA

ABSTRACT:

Field investigation of living crocodiles and as a delegate to the Third International Gondwana Symposium in 1973, as well as a second investigation in 2001 to Australia provided me with opportunities to add important specimens to SMM's research collections. Those opportunities were augmented by the staff and associates of the National Museum of Australia, Melbourne; the South Australian Museum, Adelaide; and the Queensland Museum, Brisbane; and especially by Richard E. Smith, Science Museum of Minnesota board member, (1972—1978) and (1978—1982) who himself made numerous trips to the land downunder.

A reference size collection of specimens for the permanent holdings of SMM contains numerous remarkable fossil marsupials (Kangaroos, Wombats, etc.) among mammals; crocodiles and plesiosaurs among reptiles; and Precambrian (Ediacaran) life forms *Mawsonites* and *Dickinsonia*. Casts of numerous "Type" specimens housed in Australian museums were also acquired along with some precious opal specimens associated with the fossilization process for SMM collections are presented here.

INTRODUCTION:

Coastal Queensland afforded the best opportunities for investigating Australia's two living crocodiles *Crocodylus johnstoni* and *Crocodylus porosus* in their natural habitat. The former smaller form is found mostly in freshwater and is referred to as "freshy", inhabits billabongs and rivers. It has been compared with inhabitants of Fossil Lake Wannagan in N.D. (Erickson, 1999). *Crocodylus porosus* or "salty" shows behavior suspected for the North American croc *Gavialosuchus* (Erickson, 1996). Further work north of Brisbane on the Cape York peninsula near Point Douglas continued from my base at Carins which in 1973 was a small "sugar town" so called because of its extensive sugar cane crop which is Australia's chief export. By 2001 the most obvious changes noted were the much better roads with bridges rather than "Floodways".

CROCODILES:

South of Carins along the coast are many rivers with both freshwater and saltwater crocodiles. Here they are observed mostly by boat. Crocodiles, as elsewhere, may adapt to both and survive times of low to no water – to flood times (Figs. 1-4). In the search for living crocodile habitats near inland waterways it is not unusual to find oneself in some prime fossil areas. One important area for fossils is in and around Lake Callabonna, Andamooka, South Australia. This is also prime Opal territory --- more on opals later.



Fig. 1. Coastal Queensland, Cape York Peninsula, Prime locality of saltwater crocodile.



Fig. 3. Billabong that exists during the “Wetts” (wet season) is shared by various taxa.



Fig. 2. Lake in South Australia’s Outback that will totally evaporate during dry time leaving bottom sediments containing remains of animals.



Fig. 4. Croc habitat (Swamp) with flying foxes overhead aroused from their hanging perches among the tree branches.

After looking at billabongs, both wet and dry, to observe behavior the search turned to the important collections of fossil crocodilian material in several museums. The potential of those unusual taxa for the then current research related largely to their geologic age and paleoenvironmental adaptations. Those specimens that are shown in the gallery (Appendix II) were important in the study of North American forms such as *Gavialosuchus* (Erickson and Sawyer, 1996) and the paleopathology of *Leidyosuchus* (= *Borealosuchus formidabilis*; Sawyer and Erickson, 1998). The large form *Pallimnarchus* (SMM P76.23.26) from Alcoota Station (Fig. 5) provided interesting speculation about its possible opportunistic feeding behavior similar to that of the largest living crocodile *Crocodylus porosus*. Although referred to as “salty” this large coastal croc often invades fresh water environments as noted above. In some wet environments of standing water, it has the ability to lunge out of the water over a meter or more to “snatch”, for example, a large fruit bat that is positioned on a low overhanging tree branch (pers. observ.) (Fig 5). Fig. 4 shows such a location with the air filled with “flying foxes” (fruit bats).

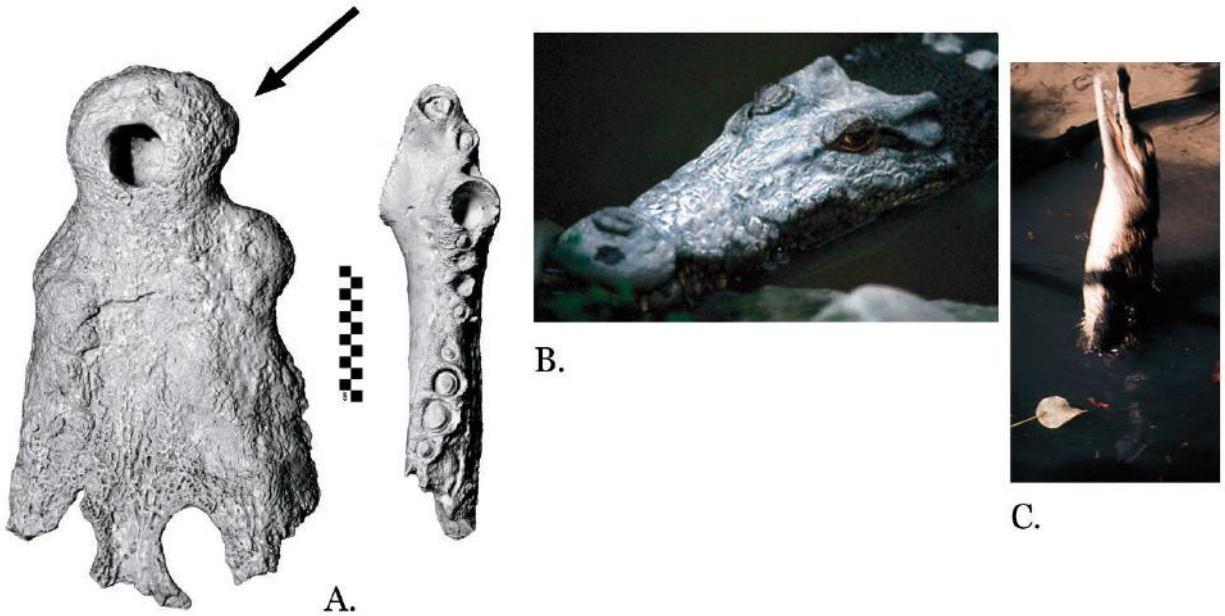


Fig. 5. *Pallimnarchus* large broad snout fossil crocodile from the Pliocene and Pleistocene deposits of inland waterways of Queensland. A, Here its wide rostrum with its bulbous nasal area are shown (arrow), B, head of *Crocodylus porosus*; C, lunge above water.

ANDAMOOKA AND OPALS:

Andamooka, South Australia and Lake Callabonna, so called because it is a playa lake meaning its shallow basin quickly gathers water which quickly evaporates leaving mud flats or “playas” to mark its position.

The lake’s hardened waterless surface “duricrust” or “caliche” is it’s most characteristic condition. In this region as well as elsewhere in the outback, preservation of fossils is often by opalization, a process by which bone cells of vertebrates and the shells of some invertebrates are replaced as “pseudomorphs” of the original structures of the shells of bivalves (clams) (SMM 91.27.) by quartz, often “precious opal” (Fig. 6). The precious opal shown here is white opal and characterizes opal in Andamooka, South Australia. Another variety of precious opal, often called “black opal” (SMMG91.1.1) is found in Queensland and elsewhere shows fire unlike other opals (Fig. 7).

Opal is usually found underground in veins where it is mined just beneath the surface. With an open pit as access to the vein (mine), excavated matrix material is disposed of by bringing it to the surface where it is spread around the pit opening. The process of “Noodeling” takes place as those spoil piles are searched and picked over for overlooked opal fragments. Occasionally bits of precious opal are recovered in this way.

Two especially large precious opal specimens (Fig. 8) at 6 lbs. 14 ozs. and 19 lbs 8 ozs. from the Andamooka area of South Australia were collected by Dick Smith and presented to SMM for our permanent collections in December 1968. A “boulder opal” is also included. With little hesitation they were accepted by the paleontology department of SMM. Again in 1971, Smith presented the museum the opportunity to acquire a newly found and undescribed plesiosaur skeleton (also from the Andamooka, Bulldog shale) which is represented here by one of its large paddles (P71.1.1) (Fig. 9). This specimen is important because it may be a new species and it is preserved in an opalized condition. After we expressed great interest in this specimen, Smith with his Australian collectors recovered the specimen for SMM’s research collections. The skeleton’s surface is coated with a patina or calcification which partly limits the “Fire” (play of colors) but does not affect its scientific value.

A meter or two below the ground surface veins of common and precious opal occur as hydrated quartz that replaces porous structures such as shell and bone. On occasion a vertebrate skeleton is discovered as an opalized



Fig. 9. Plesiosaur hind paddle (SMM P71.1.1) covered with deposit (patina) which hides its play of colors. This specimen is from the Bulldog shale (Aptian) of Andamooka, same area as materials as described in Fig. 10.

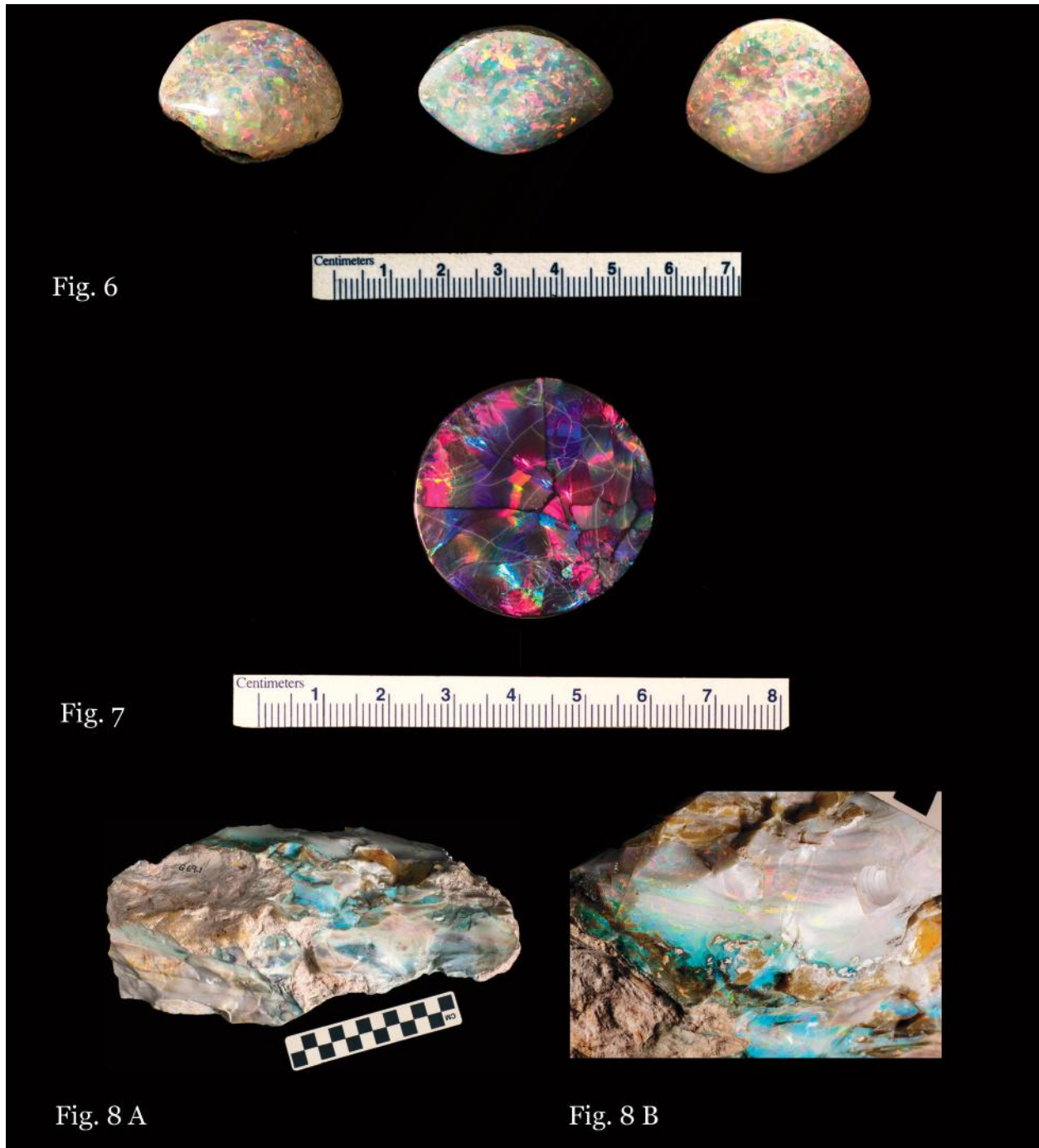


Fig. 6. Three pseudomorphs (precious opal) of bivalves (clams) characterize the opalization of fossils found in the Andamooka region of South Australia. This is referred to as white opal (lot of 3 specimens, SMM P 91.27.1).

Fig. 7. “Black Opal” specimen (SMM G91.1).

Fig. 8. Precious opal matrix: A, (G69.1.1), weight 6 lbs. 14 ozs; B, (G91.1.2) 19 lbs. 8 ozs. both from the Andamooka region of South Australia.

pseudomorph. Plesiosaurs are occasionally fossilized in this way. Several exceptional specimens were recovered in the 1970's for the museum's collections. A composite of an adult and at least two young individuals are shown in Fig. 10. Those two or three juvenile skeletons from Andamooka pose a familiar research problem. The specimens are not identified to their generic level and need preparation and further analysis to properly place them taxonomically. According to Neville Pledge of the South Australian Museum several species may occur in the Andamooka area (pers. comm.). It is necessary that they all will eventually be described and named properly.

Plesiosaurs are reptiles occurring in both marine and freshwater strata of several areas especially Queensland. The material presented in figure 10 is provisionally identified as the genus *Woolungasaurus*. The plesiosaur noted above (Fig. 9) recognized by its opalized hind paddle is a larger individual and partly complete like the others of the same assemblage. The fragmentary condition is not unusual and indicates that associated bones of those individuals may be present or may have been lost during the preservation process.

Many young plesiosaurs (disarticulated elements) are present in the Bulldog Shale (Aptian) of Andamooka. The smallest vertebrae are only 1.5 cm in length and some propodials only 150 mm. Most teeth are small, recurved, and sharply pointed. The associated paddle (Fig. 9) is that of an adult. The hyperphalangyal paddle is readily distinguished by its constricted phalanges unlike the broad phalanges of any mixing of ichthyosaur material.

The fossil turtle *Meiolania platyceps* that became extinct during the late Pleistocene has unusual features of its skull and tail. It inhabited Queensland, New Caledonia and Lord Howe Island located some 400 miles east of Australia. Originally in 1881 it was identified as a giant, horned lizard because of its large armored skull that is equipped with horns and spikes (Fig. 11).



Fig. 11. Skull of horned turtle *Meiolania platyceps* (SMM P76.23.4c) that inhabited Lord Howe Island East of Australia in the early Pleistocene. Arrow indicates the orbits in (enface view). New discoveries of *Meiolania* 1970s were studied at Victoria (Natl. Mus. Of Aust.) by BRE 1973.

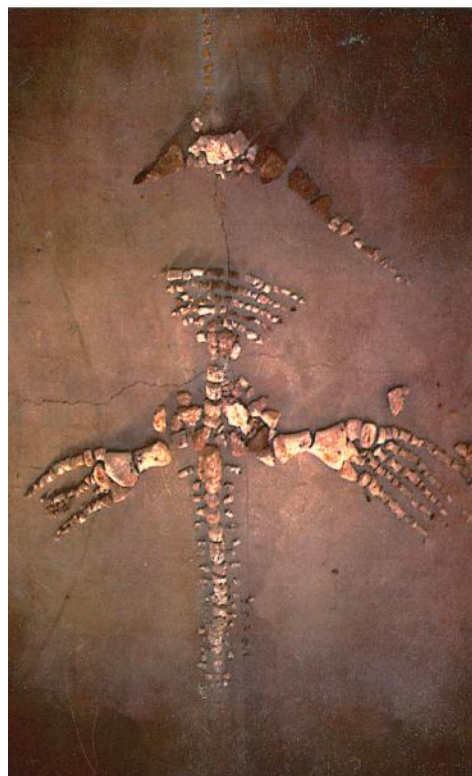


Fig. 10. Composite skeleton of adult and young (juvenile) bones from the same area suggesting that it was a nursery site for plesiosaurs. This skeleton was articulated to assist in determining the relative ages of the various bones.

The tail of this remarkable turtle is also armored with a sheath of bone covered with spikes. A cast of this specimen in the Australian Museum (F: 57984) provided SMM's cast material and its documentation.

Avian fossils are not uncommon. Their traces stem from the early Cretaceous over 70 million years ago. The record is sketchy being established on a variety of small feathers (Rich and Tets, 1982). It was not until 10 – 20 million years ago during the Miocene that over 40 families of birds were present in Australia. Most of those are broken bones and preserved as their most durable parts of the humerus, femur, tibiotarsus, and Tarsometatarus.

Largest of the Australian birds belong to the families Dromornithidae (Mihirungs) and Casuariidae (Emus and Cassowaries) (Fig. 12), represented in SMM's collections. Largest of the dromornithids may have rivaled *Aepyornis*, the elephant bird of Madagascar, at least in the size of its eggs with a capacity of some two gallons.



Fig. 12. Some durable fragments of dromornithids; Australia's giant fossil birds: A, Tarsometatarsus, distal end; B, Left femur, distal end; C, left tibiotarsus, distal end. Number for all: SMM P81.8.

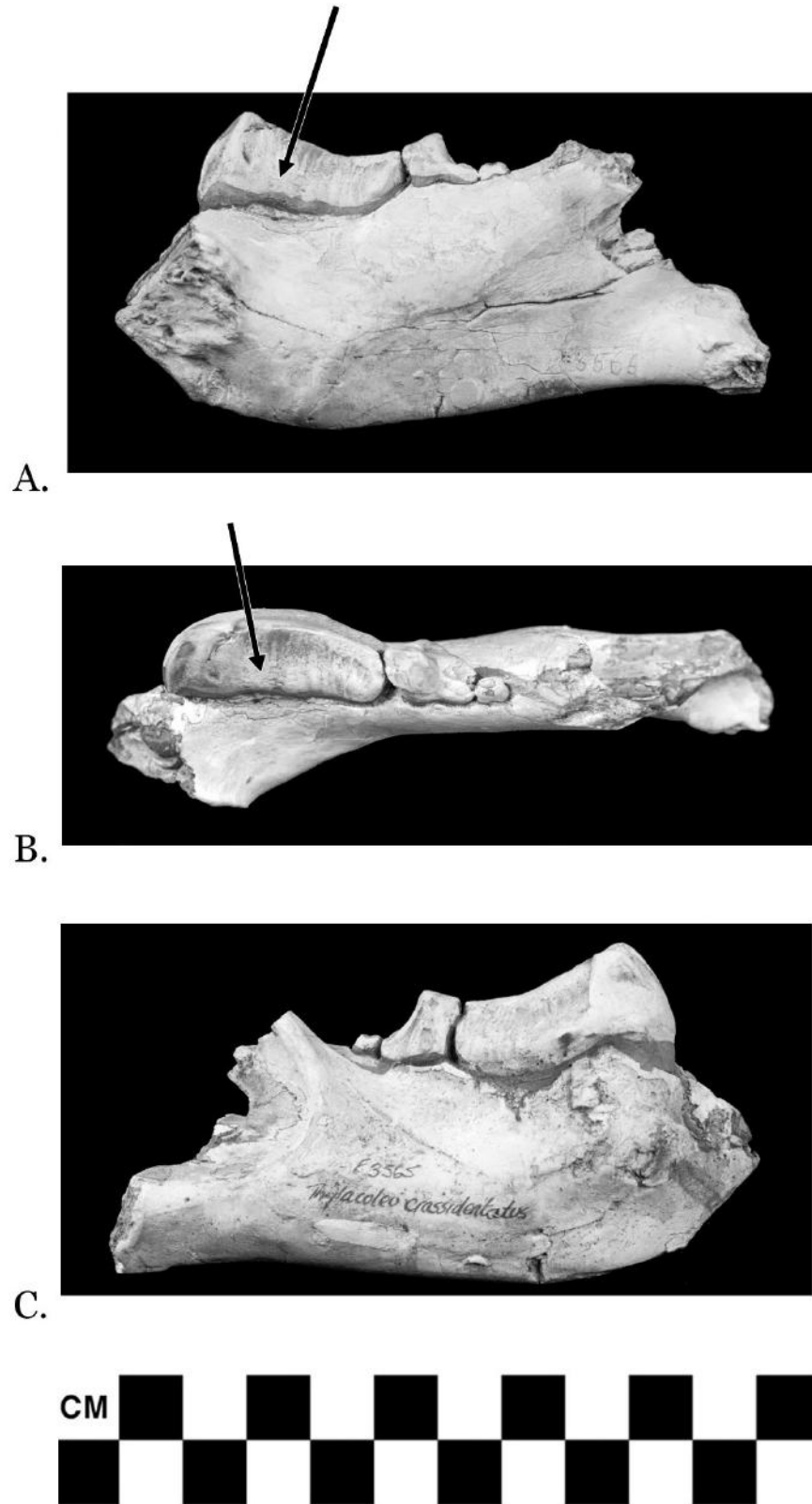


Fig. 13. Right mandibular half of the marsupial *Thylacoleo carnifex* showing: A, carnassial tooth blade in medial view (arrow); B, carnassial tooth (arrow) in occlusal view; C, lateral view.

MARSUPIAL ADAPTATIONS:

The endemic mammalian fauna of Australia is made up of Monotremes (egg – laying) and Marsupials (pouched) forms that apparently date from the late Oligocene. With exception of bats this fauna contained no other mammals until the arrival of the rodents in the Pliocene. The echidnas and the platypus are known from Quaternary deposits and are very like their living counterparts (Rich, 1982). The Frontispiece shows examples of the two living monotremes. Today the living echidna *Zaglossus* is found exclusively in New Guinea (Murray, 1978). The largest group of marsupials including Kangaroos, Koalas, Wombats, Bandicoots, etc. are widespread in most of the herbivore niches over much of the Australian continent. The female of each species posses a marsupium (abdominal pouch) for carrying the young until they are fully developed.

Australian marsupials include marsupial mice, rats, native cats, moles, bandicoots, phalangiers, Tasmanian wolf, Tasmanian devil, Koalas, wombats, rat kangaroos, kangaroos, wallabies (small Kangaroos of the genus *Wallabia* and related genera), and wallaroos (Kangaroo of the genus *Macropus*). “Possum” refers to forms of the Australian region; “Opossum” refers to a New World pouched mammal.

Australia’s mammalian fauna displays many remarkable adaptations in its osteological and dental development. Aside from the noted marsupium, numerous specializations reflect the behavior of hopping and scrambling over rocky surfaces such as found in the outback and around lava tubes.

Dental anomalies are outstanding examples found in the third premolars (P3) of *Thylacoleo* and *Propleopus*. In *Thylacoleo carnifex* a probable decendent of phalangerids, the third premolar has been greatly modified and enlarged as a curved carnassial blade originally thought for carnivorous feeding (Fig. 13 A B C arrow). It is the largest such modification found in mammals (Van Valen, 1961). *Propleopus* another phalangerid also developed a third unusual premolar having a striated vertical crown that is reminiscent of that of some North American multituberculates, an extinct subclass of mammals (Fig.14).

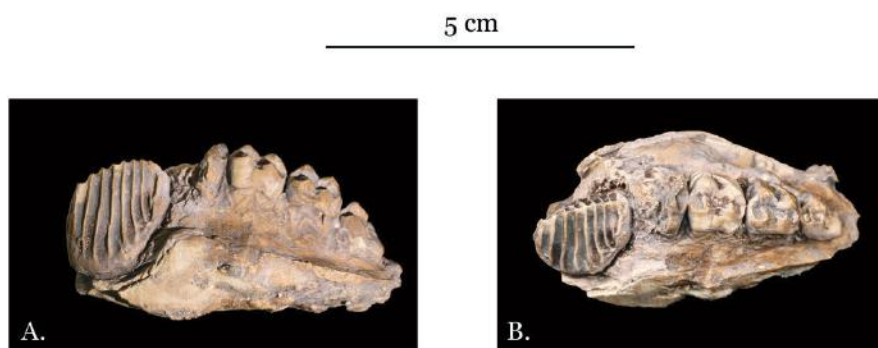


Fig. 14. Dentition of the Kangaroo *Propleopus* showing its remarkable teeth with its fluted premolar; A, lateral view; B, occlusal view.

AUSTRALIAN GIANTS:

When compared with other Pleistocene faunas of the world Australia has its share of remarkable development among its taxa. Gigantism of a number of extinct groups near culmination is not uncommon.

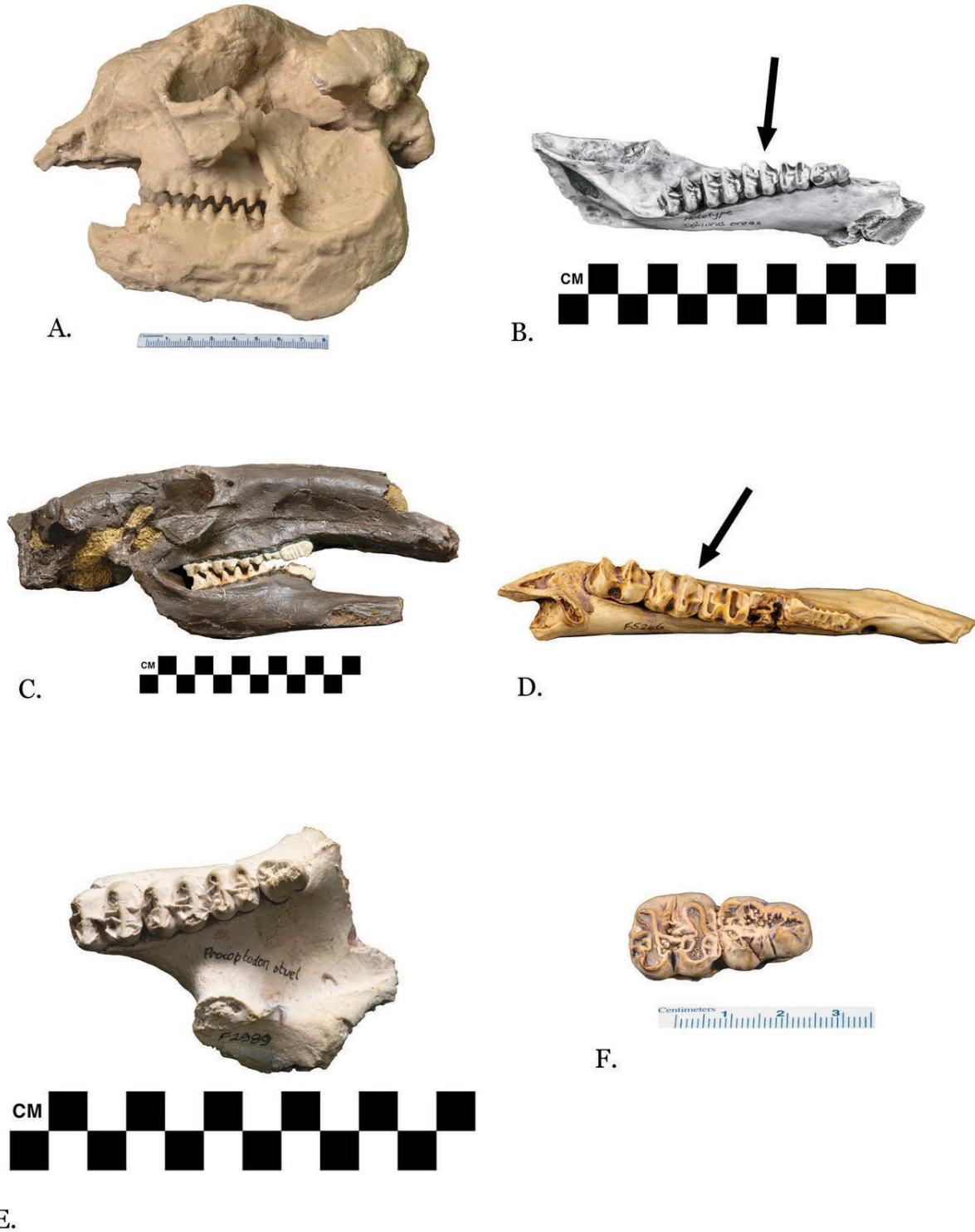
Among reptiles the huge crocodile *Pallimnarchus* discussed above was apparently about the size of *Crocodylus porosus* the largest extant crocodile and its taxonomic status is still uncertain (DeVis, 1886).

Kangaroos of the Miocene were small; however, by the late Miocene large species had developed. *Procoptodon goliath* was the largest known standing 3 meters high. It was likely a tree browser. The short-face *Sthenurus* (Fig. 15A) was probably a grassland grazer while the longer snouted *Protemnodon* with its crenelated teeth (Fig. 15B) was a probable browser on bushes. The largest kangaroo *Procoptodon* has extreme crenellation of its dentition (Fig. 15C). All three of those Roos are represented in the Pleistocene deposits of Australia and all had different feeding habits..

Diprotodonts are large quadrupedal marsupials also recognized by their double lower incisors and molar teeth with two transverse lophs that indicate its browsing habits (Fig. 16). They also possess a twin structure of a syndactylus foot. Those herbivorous mammals are frequently located in Pleistocene deposits of Lake Callabonna which is often referred to as the “*Diprotodon* Graveyard”. One species *Diprotodon aptatum* has the distinction as the largest marsupial of all time. It has been likened in size to a modern day rhinoceros. Its vertebra indicate its form and its great size (Fig. 17).

Generalized features of this unusual marsupial are shown in my field notes of July 1973 (Fig. 18). Observe the crowned skull with its prominent incisors and secondary tooth development. Also note the marsupial element that is support for the marsupium (pouch).

The colossal dromornithid tarsometatarsus shown in figure, 12 A, was a common gigantic form that occurs in the Pleistocene deposits among other large ground dwelling birds.



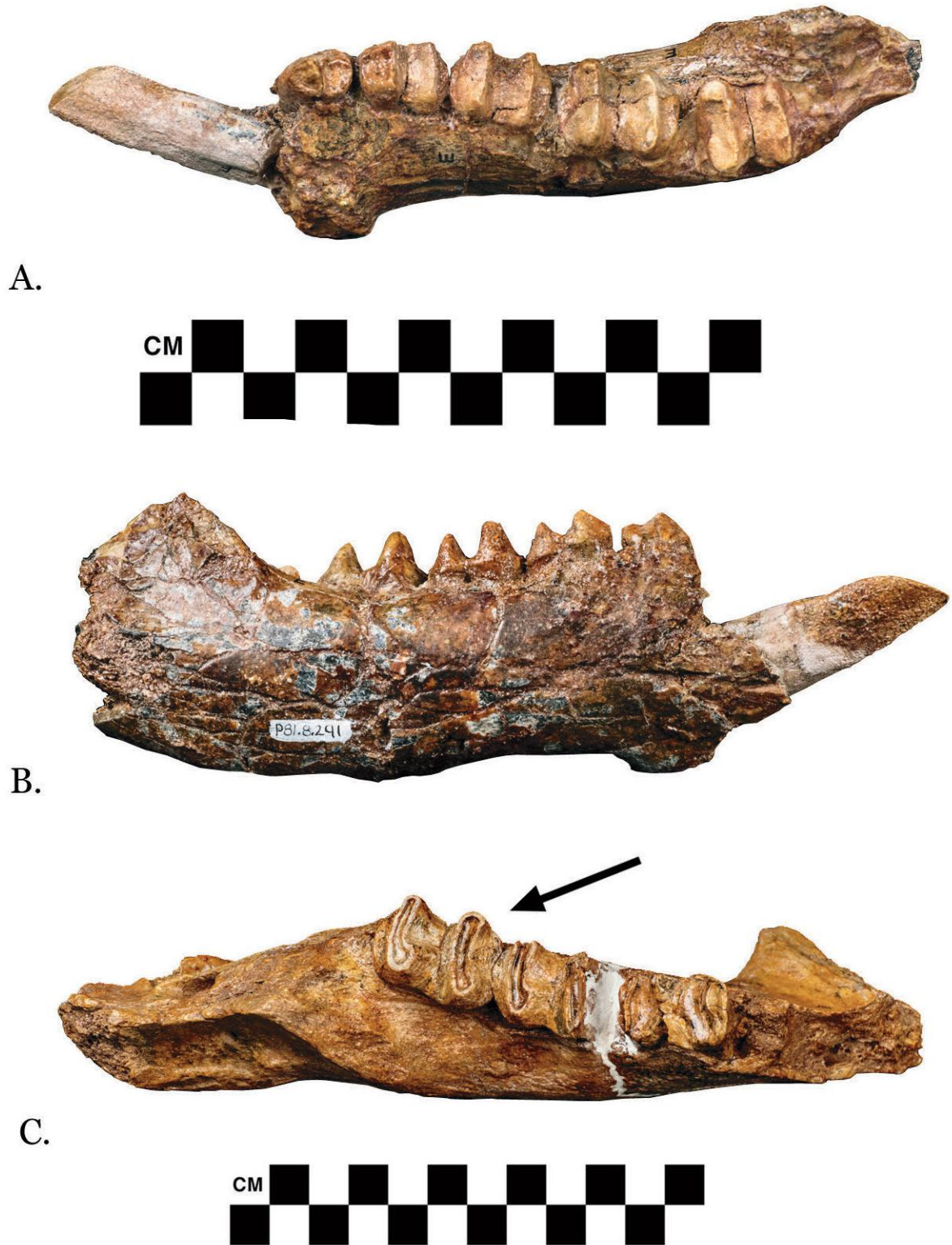


Fig. 16. *Diprotodon* right mandible (SMM P81.8.292): A, shows in occlusal view, teeth, each with two transverse lophs indicating browsing habits; B, lateral view showing height of lophs (SMM P81.8.241), C, large right mandible showing two loph molars (arrow).

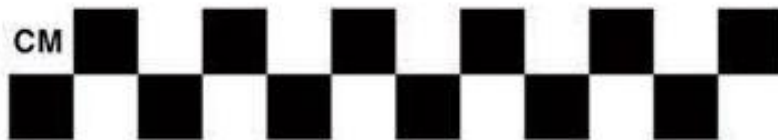


Fig. 17. Largest of all marsupials, a *Diprotodon* vertebra (SMM P81.8.189) is shown here in posterior view.

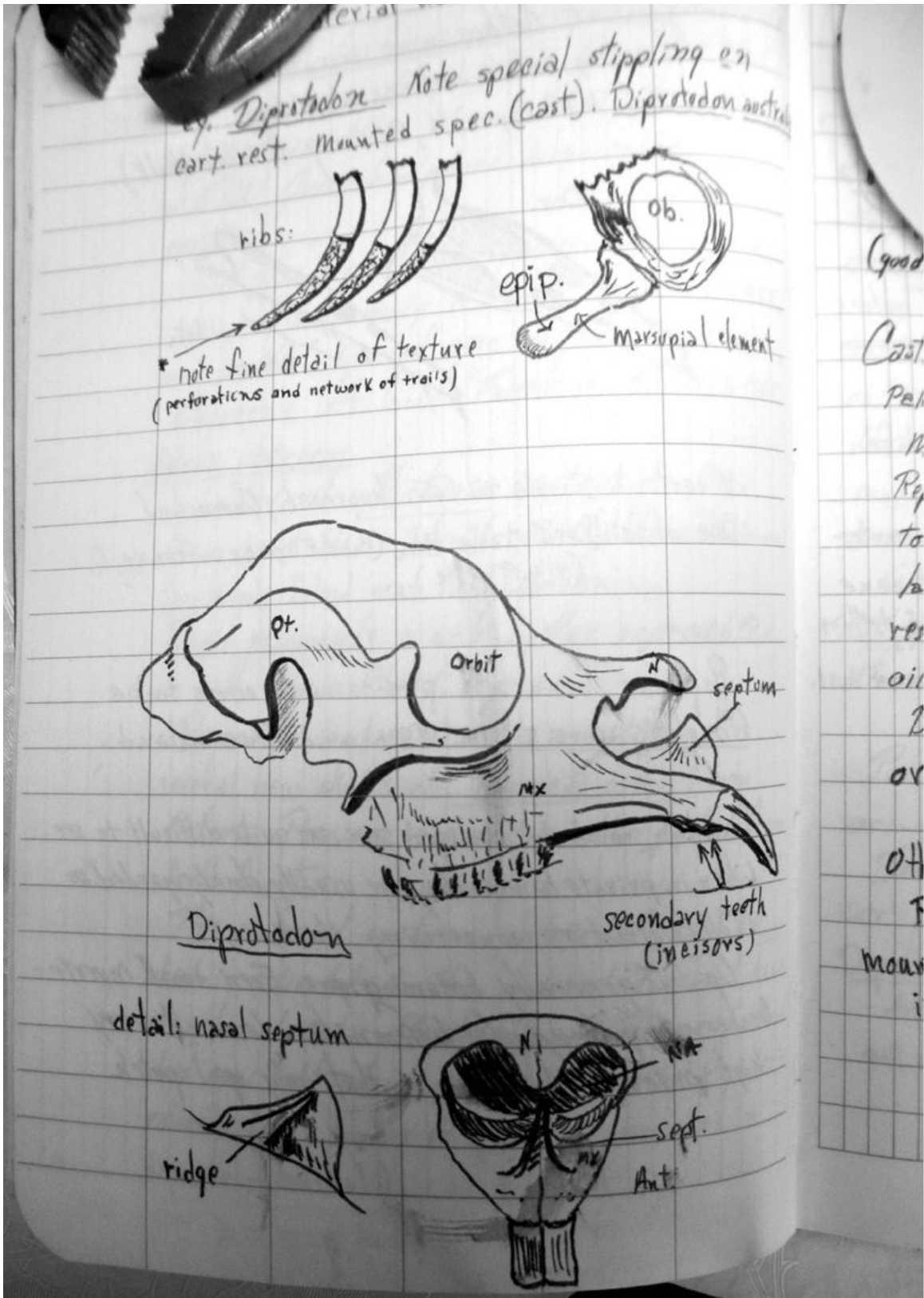


Fig. 18. Page from my field notes of July 1973 illustrates various features of *Diprotodon* skull and skeleton.



A.



B.

Fig. 19. Two Precambrian trace fossils A, *Mawsonites* sp. (SMM P76.73.8c) and B, *Dickinsonia* sp., without hardparts (skeletons) are known only by their impressions that were made in bottom sediments during Ediacaran time of South Aust.

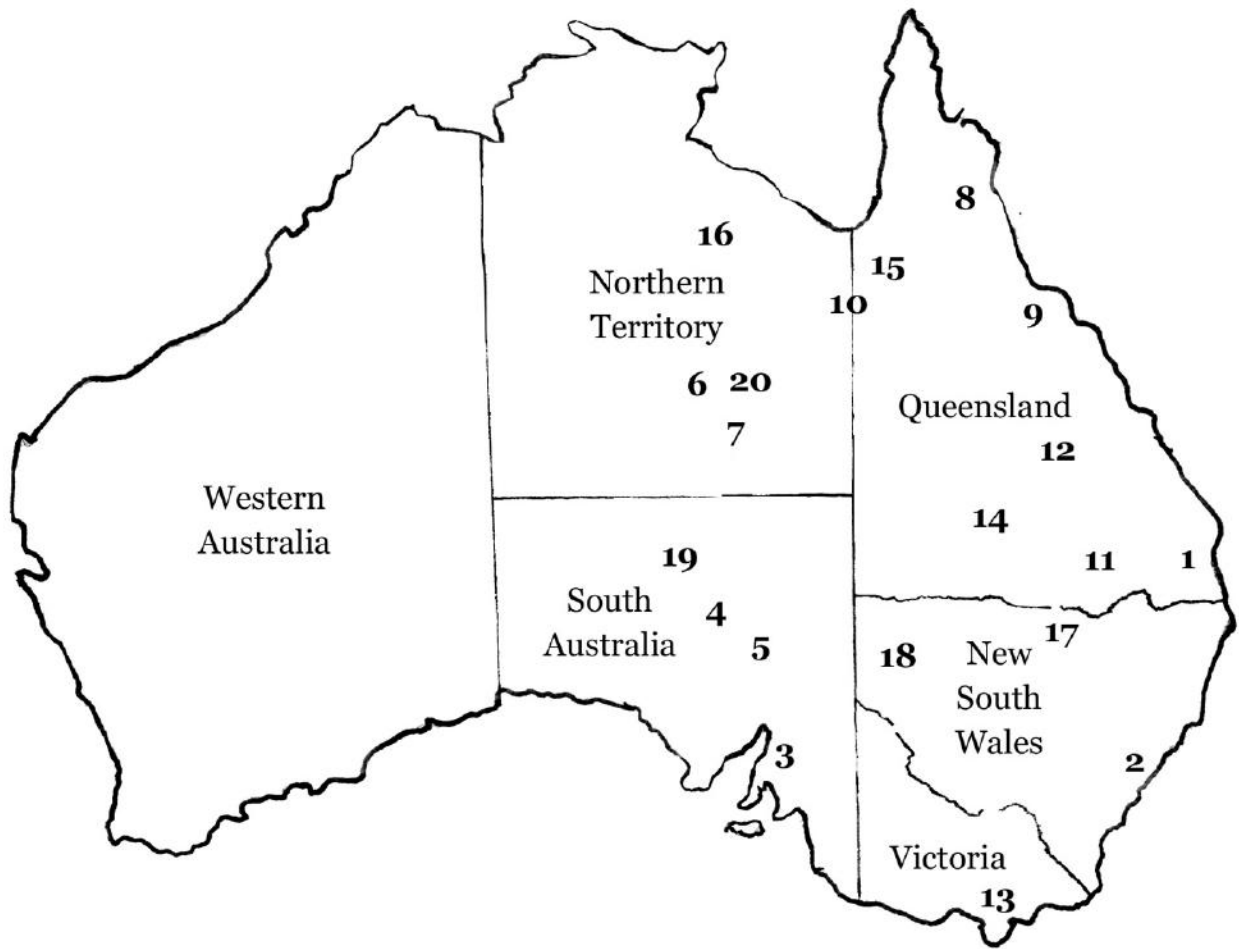


Fig. 20. Map of localities in Queensland, New South Wales, South Australia, and Northern Territory that yielded the specimens and the research area covered in this paper. 1, Brisbane; 2, Sydney; 3, Adelaide; 4, Andamooka; 5, Lake Callabonna; 6, Alcoota Station; 7, Kangaroo well; 8, Cooktown; 9, Carins Crocodile coast; 10, Atherton Tablelands; 11, Darling Downs; 12, Landowne Station; 13, Melbourne; 14, Bluff Downs; 15, Riversleigh; 16, Canfield beds; 17, Lightning Ridge; 18, Broken Hill; 19, Coober Pedy; 20, Alice Springs.



Fig. 21

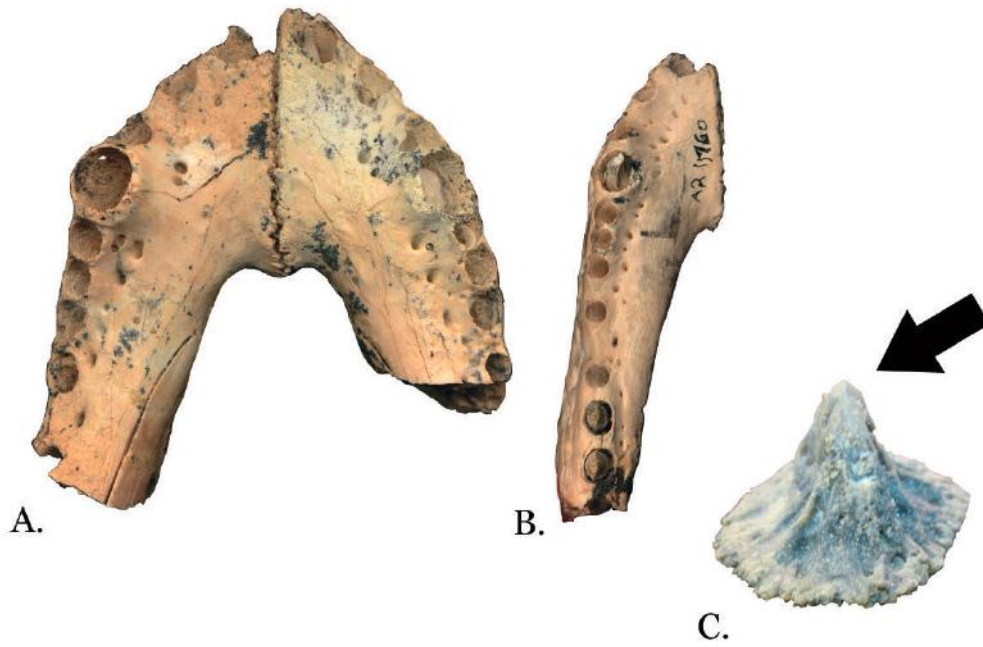


Fig. 22

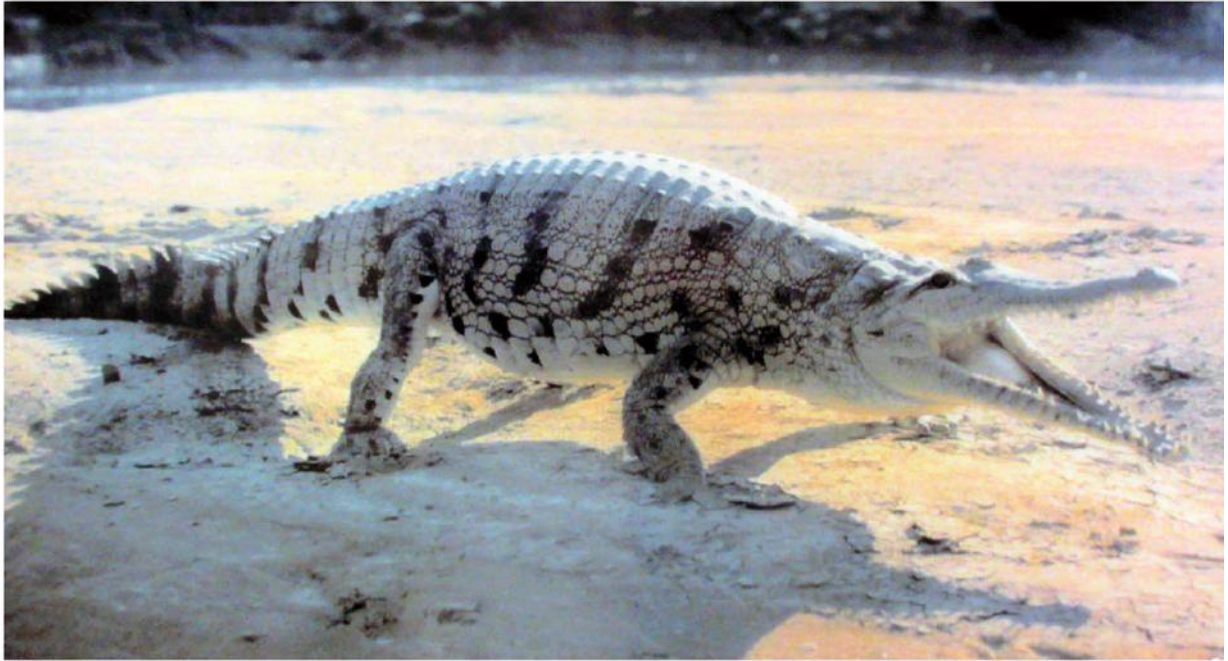


Fig. 23

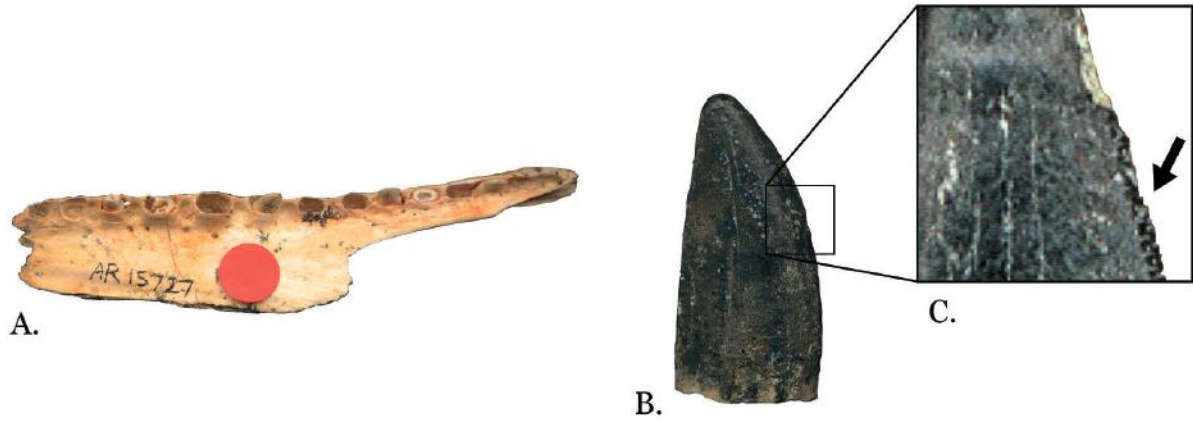


Fig. 24

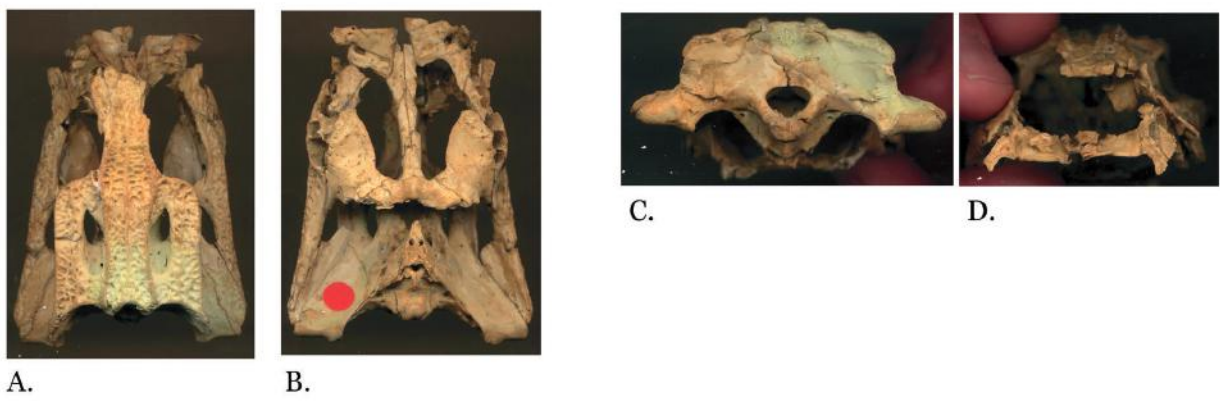


Fig. 25

EARLY EVIDENCE

Two of the earliest inhabitants (Fig. 19) of Australia are preserved as trace fossils (ichnites) from Flinders Range, South Australia. Those forms did not have hard parts such as shell or bone, therefore the record of their existence is found only as impressions and molds which were made in bottom or beach sediments during Late Precambrian Ediacaran Time. In the broadest terms the earliest forms of life are found in the fossil records of the Fig Tree Formation of South Africa some 3 billion years ago; the Gunflint Formation of Ontario, Canada 2 billion years; and in the Bitter Springs region of South Australia at 1 billion years in the past. Casts were made from natural rock molds (impressions) of *Mawsonites* and *Dickinsonia* from Flinders, South Australia that date from Precambrian time. Casts of those two taxa were made in the field and are now in the “trace fossil” collections at SMM. *Mawsonites rendellensis*, a probable Late Precambrian Syphozoan (Sun Wei-Gue 2008) and *Dickinsonia* from lagoonal—Aeolian deposits of Ediacaran time (G.I. Retallack 2013) are described in Nature 493: 89-92, Jan. 2013.

ACKNOWLEDGMENTS

In Australia Ed Gill and Tom Darragh, National Museum; Tim Flannery and Neville Pledge, South Australian Museum; Mary Wade and Sven Sachs, Queensland Museum; provided invaluable assistance with locality information and specimens Oke Blomquist, Cairns loaned the use of his boat and his guidance to many crocodile localities.

I also express my appreciation to Richard Smith for sharing his knowledge of fossil localities as well as his most generous additions to SMM's fossil and opal collections. I thank Ray Lemley for donation of his personal collection of Australian fossils and casts. Brooke Erickson assisted with collecting various specimens. Lois Erickson assisted with field research in Australia during 1973 and 2001, also did review and processing of this publication. Figures 5 – 19 including the frontispiece were produced by Mark Ryan, SMM. Tim Erickson completed redacting of all figures. I am indebted to Becky Huset and Richard Benson for their careful and important reviews.

The monograph and the research in its production were made possible by the Philip W. Fitzpatrick Paleontology Research Fund of the Science Museum of Minnesota.

APPENDIX I

Fossil Marsupials Represented In the Collections of the Science Museum of Minnesota.

Taxon	Taxon
<i>Dasyurus lanianus</i>	<i>Procoptodon atael</i>
<i>Diprotodon minor</i>	<i>Procoptodon rapha</i>
<i>Diprotodon optatum</i>	<i>Procoptodon</i> sp.
<i>Diprotodon optatum</i>	<i>Proleopus chillagoensis</i>
<i>Diprotodon</i> sp.	<i>Protemnodon ch</i>
<i>Euryzyoma duorene</i>	<i>Proatemnodon antaeus</i>
<i>Hadromomas</i> sp.	<i>Protemnodon minor</i>
<i>Macropus anak</i>	<i>Protemnodon og</i>
<i>Macropus thor</i>	<i>Sthemurus atlas</i>
<i>Nothotherium mitchelli</i>	<i>Sthemurus notabilis</i>
<i>Nothotherium robuta</i>	<i>Sthemurus oreas</i>
<i>Palorchestes azael</i> (<i>P. crassus</i>)	<i>Sthemurus</i> sp.
<i>Phascolomys medius</i>	<i>Thylacoleo crassidentatus</i>
<i>Phascolomys thompsoni</i>	<i>Thylacoleo oweni</i>

APPENDIX II

Gallery of Extant and Extinct Crocodiles Examined in Australia.

Fig. 21. *Australosuchus clarkae* SAF 18152: A, left mandible showing festooning in lateral view; B, same in medial view, loc: Lake Palankarinna, S.A.

Fig. 22. *Baru huberi* QMF 31069: A, mandible, dorsal view; B, same showing alveolar size, number, placement; :Loc: Riversleigh stn. N.W. Qld; C, high crest osteoderm; Loc: Golden Fleece Sand quarry S.A.

Fig. 23. *Crocodylus johnstoni* (living species), “Freshy” during “high walk”, N.E. Qld.

Fig. 24. *Quinkana meboldi*: QMF 31056: A, Holotype maxilla; B, ziphodont tooth; C, enlargement of serrations similar to some carnivorous dinosaur teeth.

Fig. 25 *Trilophosuchus rachami* QMF 16856: Holotype skull, Riversleigh Station, N.W. Qld; A, posterior dorsal view; B, same in ventral view; C, posterior view; D, anterior view.

- *Harpacrochasma canfieldensis*, from Northern Territory quarry.
- *Baru darrowi* new species from Golden Fleece Sand Quarry, So. Aust.

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