Dig at Dinosaur Cove

1985

Camptosaurus jaw x2

Excavation at Dinosaur Cove, 1985

Summary

Seven week's excavating at Dinosaur Cove during the Summer of 1985 yielded more than just the 300 specimens of fossil tetrapods recovered. Probably the most significant discovery was the recognition of a fossiliferous layer at Dinosaur Cove East that can be more readily excavated than any previously found in the Otways. Known to cover at least 35 square metres, six times the area thus far excavated at Dinosaur Cove, this new unit will require a minimum of three field seasons to collect under the current staffing.

In addition, it is now recognised that conglomerates formed of clay galls which occur at the base of thick sandstones overlying thick claystones are likely to preserve and thus contain fossil bones. This realisation provides a valuable clue to locating fossil sites. Now, for the first time, it is possible to locate likely fossil sites without first finding a fossil bone. Rather, one can identify a promising suite of rock types, a much easier thing to do than detect the often cryptic bones themselves.

Background

As a result of last year's fortnight long excavation at Dinosaur Cove, two points were established. First, a fossiliferous layer at the Dinosaur Cove East site was found to continue north and east. Second, a new site, Dinosaur Cove West, was discovered and produced about 3 square metres of readily excavated fossiliferous rock. It seemed reasonable that more was to be expected if the difficult task of excavating into the adjacent cliff were undertaken.

During the past year, preparation by Elizabeth Thompson and Leslie Kool of specimens found in February, 1984, established that the collection included several well preserved bones. Among these were a femur (or thigh bone) of the smallest Australian dinosaur found to date, an individual about the size of a bantam chicken, and the second record of a pterosaur (flying reptile) from this continent.

On this basis, it was decided to carryout a seven week excavation at Dinosaur Cove in 1985. With sponsorship from the Friends of the Museum of Victoria, the Council of the Museum of Victoria, the Atlas Copco Corporation, the Ian Potter Foundation, and the National Geographic Society, work commenced on 18 January 1985 and was completed on 10 March 1985.

The Excavation

As no helicopter was available to transport equipment into Dinosaur Cove at the beginning of the excavation, everything had to be carried in by the workers. Two bamboo poles generously supplied by the Royal Botanical Gardens made it possible for as many as six people to carry items in that a single individual could not lift.

Initially, work concentrated at the Dinosaur Cove West site. Ten days were devoted to excavating and going through the easily quarried fossiliferous rock from there. More than 100 fossils were found during this phase of the work.

During the next few weeks, effort was equally divided between the two sites, Dinosaur Cove West and Dinosaur Cove East. Initially, recovery of further fossiliferous rock was a slow process because of the problems of removing overburden. Two different approaches were taken to solving this difficulty. At Dinosaur Cove East, the tunneling commenced in 1984 was continued. At Dinosaur Cove West, on the otherhand, 3.5 metres of sandstone overburden was removed to expose the 15 centimetre thick fossiliferous layer. Working in this fashion, almost all the fossiliferous layer at Dinosaur Cove West had been excavated by mid-February.

When initially found, the fossiliferous layer at Dinosaur Cove West was exposed for 14 metres along the outcrop. However, it was found during the 1985 excavations that at no place did it extend into the cliff for more than 1 metre. That the fossiliferous body of rock should have been so closely aligned to the present outcrop was both a surprise and a disappointment. When first discovered, it had seemed likely that such an extensive exposure heralded the presence of a considerable quantity of fossiliferous rock.

Meanwhile at Dinosaur Cove East, a fortuitous accident occurred. Breaking out a rock with part of the fossiliferous layer in it, another, similar layer was found to lie beneath that producing unit. Realising that they were probably standing on more of this lower unit, the diggers temporarily abandoned their efforts to extend the tunnel further eastward into the vertical face and started the much easier task of digging downward to remove the newly found layer which was literally only a few centimetres below their feet.

Following this lead for the final fortnight of the excavation, they worked progressively out of the tunnel and towards the sea. Having only to dig downward less than 1 metre, in that short time they were able to uncover 35 square metres of fossiliferous rock. By contrast, it had taken three times as long (six weeks over two field seasons) to expose 5 square metres of the fossiliferous layer by tunneling. For the most part, the fossiliferous layer exposed during this final fortnight was left intact. Rather, the effort was directed towards determining its

extent. So far, no limit in any direction has been found. Despite this, three or four tonnes of fossiliferous rock was collected together with about 200 fossils at Dinosaur Cove East. To excavate the 35 square metres now known to be at Dinosaur Cove East will require at least three six-week field seasons using a crew of ten persons.

Despite the relative ease of excavating the shore platform at Dinosaur Cove East, the tunneling effort there should not be abandoned. One of the best finds of two season's effort at Dinosaur Cove was made at the very back of this tunnel, a jaw tentatively referred to the ornithopod dinosaur Camptosaurus and illustrated on the cover of this report.

During the final fortnight of work at Dinosaur Cove East, it was also established that directly beneath the lower most fossiliferous layer is a thick claystone. Above the fossiliferous layer, the rock is a massive sandstone with almost no coarser particles than sand grains. At Dinosaur Cove West the same situation also occurs and is much more readily observed: massive sandstone with a fossiliferous layer at the base, which in turn is underlain by a thick claystone.

The claystone represents a period when water currents bringing sediment into the area were so weak that particles even as small as sand grains could not be transported to the site of deposition. The abrupt transition to sandstone represents a sudden increase in the competency of the water flowing into the area. At the boundary, the mixture of chunks of clay, fragments of wood, and the rare bone or tooth in a sand matrix probably was the result of this increased water flow transporting accumulated debris from the surrounding area into a depression. Previously, the debris could not be moved into the area where the claystone occurred because the rate of water flow was not sufficient to mobilise the organic material.

Once this common feature between Dinosaur Cove West and Dinosaur Cove East was realised, it provided an excellent tool for the discovery of additional sites. The procedure to find other sites is to simply look along the base of a massive sandstone over a claystone for concentrations of clay galls and fragments of carbon. Using this clue, a third site was found at Dinosaur Cove within half an hour of starting the search. After another half an hour of digging there, three bone fragments had been found. For the first time, a fossil tetrapod site was found in the Victorian Cretaceous where no bones had been seen initially on the surface. Dubbed the Slippery Rock site because of the algae covering much of the locality, it warrants future investigation.

The following persons participated in the excavations at Dinosaur Cove in 1985.

Gerry Alkin

Johnathan Morton

April Barratt

Gavin Bastienz

Bruce Brown

Michelle Colwell

Leeann Davey

Amanda Gordon

Mark Griffith

Tony Hill

Richard Kay

Leslie Kool

Joan Lamond

Neal Padbury

Thomas Rich

Natallie Schroeder

John Smith

Kenneth John Smit

Anabelle Stewart

Robert Tranter

Sanja van Huet

Keryn Walshe

Michael Whitelaw

Lester Young

Among the people who contributed substantially to the success of the excavation by the supply of equipment and expertise were:

Don Anderson

John Carpenter

David Denney

Winsome Denney

Alan Evans

John Herman

William Loads

Peter O'Rourke

Elizabeth Thompson

Chris Wilkinson

Joy Wilkinson

Jim Wilson

Evaluation of Equipment

Atlas Copco supplied a variety of pneumatic and petrol driven rock drills and breakers to assist in the excavation. The most effective were the heaviest provided: the lighter tools were unable to penetrate or break the relatively hard rock at Dinosaur Cove. The pneumatic rock breakers which were most effective were the TEX 11 and TEX 21. The most effective pneumatic drill was the RH 571. A petrol driven COBRA 148 combined rock breaker and drill was also extremely useful. Except for some initial difficulty with the TEX 11, all this equipment worked extremely well.

Air for the pneumatic tools was supplied by a XAS80Dd diesel driven air compressor mounted on a trailer. As the compressor

could not be transported into Dinosaur Cove, 700 metres of hose were used to supply the air to Dinosaur Cove East and West. An air bottle was employed to overcome the problems of pressure loss through such a great distance of hose. This item of equipment was extemely reliable.

Besides the rock breakers, the other principal method of excavating rock was to drill a series of holes and use plugs-and-feathers. This method was particularly effective when excavating the overburden above the lowermost fossiliferous layer at Dinosaur Cove East.

Experiments were carried out using an expanding clay to break rock. The clay was mixed with water and poured in a series of holes. Over 24 hours, the clay hardened, expanded, and tended to crack the surrounding rock. Unfortunately, the results achieved under the conditions at Dinosaur Cove East were not encouraging.

Pneumatic, electrical, and petrol driven rock grinders were successfully employed to excavate around specimens once they were seen. By cutting slots on all sides of a specimen with these tools, it was possible to quickly pedestal them without undue vibration. Once on a pedestal, the specimen could be undercut and removed from the excavation site with little difficulty. Last year, several specimens were damaged when attempts were made to cut around specimens found in place with a hammer and chisel. This was owing to both the vibrations from the impact of the chisel on the rock and the tendency of the rock to fracture in a conchoidal manner.

Scientific Results of the 1984-1985 Excavations at Dinosaur Cove

Very little of the material collected during the 1985 excavation has yet been prepared or analysed. Most fossils collected this year are presently known only as random cross-sections of bone still enclosed by rock. Months of effort will be required to prepare them for study. However, it is already clear that the jaw tentatively referred to Camptosaurus and illustrated on the cover of this report is a most valuable contribution to knowledge of Australian dinosaurs. Previously, two upper tooth rows of this same genus of animal were known from Point Lewis, a few kilometres east of Cape Otway. Last year, a single isolated lower tooth of this same dinosaur was found at Dinosaur Cove West as well. This jaw, however, reveals much more information about the lower dentition, and later this year I intend to compare it with undoubted Camptosaurus material and other similar dinosaurs from Europe, Africa, Asia, and North America. This will either establish that the Victorian dinosaur is one new to science or that it is a member of a group previously known on other continents. If this dinosaur is indeed Camptosaurus, it would not only mean that this Northern Hemisphere form also reached Australia, but that it lived here about

30 million years after its youngest known record elsewhere. If this is so, why it has this relict occurrence in Australia is an intriguing question. First, however, it identity must be established firmly.

The material referred to Camptosaurus found at Dinosaur Cove represent individuals that stood 1.5 to 2 metres high. They belonged to a group of dinosaurs known as ornithopods. There were inoffensive bipedal herbivores which looked somewhat like a kangaroo, although they apparently ran rather than hopped. One or possibly two other, smaller but similar ornithopod dinosaurs are found at Dinosaur Cove. One of these, a juvenile at the time of its death, was about the size of a bantam chicken, the smallest dinosaur remains yet found in Australia.

Another small ornithopod dinosaur is known from other Victorian sites. With three or four members of this group represented, Victoria has as many varieties of these particular dinosaurs as any other area in the world at a given age. Elsewhere, in fact, small ornithopods are a relatively rare elements of the fauna even where a number of different forms are known. Because only a few other dinosaurs are known from Victoria and their remains are quite rare, the Victorian ornithopod occurrences are doubly odd: there is a high number of them and they are by far the most common dinosaur represented.

The discovery of a single, delicate bone of a pterosaur or flying reptile is significant not only for recording the presence of this group but also because it demonstrates the potential of Dinosaur Cove East, however rarely, to yield small, fragile bones. Thus, it is now reasonable to expect that with enough work at Dinosaur Cove East, the oldest Australian bird bones will be found there. It is known that birds were in Australia by this time because of the presence of a few fossil feathers in a contemporary rock unit cropping out near Koonwarra, Victoria.

When the dinosaur-bearing rocks of Victoria were deposited, they lay within the Antarctic Circle. The land vertebrates found in these rocks lived closer to the South Pole of their day than any known from contemporaneous deposits elsewhere in the world. Yet they apparently were living in a comparatively warm climate as attested to by the nature of the fossil flora found with them, a diverse assemblage dominated by Coniferales, pteridosperms and sphenopsids and including ferns and other cryptogams from a few sites (Dettmann and Douglas, 1976). The preferences of the nearest living relatives of the animals also supports this climatic picture for they occur in areas such as Queensland and Papua New Guinea today. To document such a high latitude fauna is of interest not only to Australians but to students of the history of life all over the world.

When compared with the dinosaurs of Queensland, the most noticeable difference is in the size of the specimens. Queensland specimens tend to be of large animals and Victorian ones, small. When traces of larger dinosaurs such as the

carnivorous Allosaurus, are found in Victoria, it is the smallest identifiable elements of those animals that occur. Allosaurus is represented in Victoria solely by an astragalus (ankle bone). This individual probably stood about 4 metres high. However, several groups to be expected here, such as the sauropods (the familiar Brontosaurus and Mamenchisaurus are examples) and armoured ankylosaurs, are completely lacking. This may be related to the inability of the stream channels that flowed into what are now the known fossil sites to transport large bones, thus introducing a taphonomic bias. Or it may be that larger species were excluded because of their climatic preferences.

Future Work

A major effort next year should be directed towards the discovery of new sites. There are two reasons for this. First, other sites are likely to have accumulated in different environments. If this is so, animals previously not found, such as the larger dinosaurs, may be encountered, giving a more complete picture of what lived in this region of Australia 105 million years ago. Second, sites richer in fossils or with more complete skeletons may be found. More complete specimens would tell us more about the animals already recognised on the basis of isolated remains.

Work should also be continued at Dinosaur Cove East and the Slippery Rock site. The twin goals will be to establish whether the fossiliferous deposit at Dinosaur Cove East extends further, as well as to excavate what is already known. It is quite reasonable to expect, for example, that further excavation will lead to the recovery of specimens well enough preserved to allow us to determine whether or not a third small ornithopod was in fact present at Dinosaur Cove East.

With the realisation that the fossiliferous layers at Dinosaur Cove East are underlain by a claystone, it is an appropriate time to try and develope excavating techniques that take advantage of this fact. The ocean erodes the claystone more rapidly than the overlying sandstone. Yet in attempting to dig into the claystone with rock drills and breakers, it was no more tractable than the sandstone. If a way can be found that would allow the diggers to take advantage of the relative softness of the claystone and dig through it to undermine the fossiliferous sandstone, then that unit could be readily broken into the cavity thus formed. At the moment, no suggestion has been made which would enable the excavators to take advantage of this circumstance.

At the end of the 1985 excavation, no helicopter was available to lift out the equipment and rock samples out of Dinosaur Cove. Consequently the equipment was removed in the same manner it was brought in: on people's backs. As of this writing, nearly 8 tonnes of rock are still in Dinosaur Cove while alternative helicopter support is being sought. To alleviate

this problem in the future, John Herman and Gerry Alkin have begun working on the design for a flying fox to enable rocks and all but the heaviest equipment to be winched in and out of Dinosaur Cove.

As Dinosaur Cove East has the established potential requiring at least three further years of work and shows no signs of being exhausted then, it is now an appropriate time to investigate the possibility of establishing a field station. Ideally such a facility would not only serve to provide housing for the crew and storage facilities for equipment, but also could provide space in which to weather the 50 or more tonnes of rock likely to be removed in the next three years. My land at Emerald simply lacks sufficient space to handle such a large quantity of rock.

In light of these considerations, for 1986, it is proposed to have another expedition of seven weeks duration beginning in the first week of January. A crew of eleven persons will be sought. The excavation in Dinosaur Cove will be supervised jointly by Michael Whitelaw and Keryn Walshe, who have demonstrated their capacity to do so on the Dinosaur Cove trips of 1984 and 1985. Joan Lamond has volunteered to act in capacity as cook and Gerry Alkin and Frank Steuart have offered to be camp managers in turn. I shall be carrying out prospecting for new sites along the coastal platform between Marengo and Pebble Point together with one other member of the crew. The remainder of the crew will work directly with Ms. Walshe and Mr. Whitelaw.

A preliminary budget to carryout this work is as follows:

$1 800	Food for eleven people for 7 weeks
$23 000*	Hire of mining equipment
$750	Consumable supplies
$1 440	12 drums of diesel fuel
$100	Telephone calls
$3 000	Services of Mr. Whitelaw and Ms. Walshe
$750	Expenses of Messrs. Alkin and Steuart and Miss Lamond
$500	Motor for flying fox
$600	5 kVA generator
$500	12" electric angle grinder
$31 690	

*Mr. William Loads of Atlas Copco has given verbal assurance that his company will supply this item as they did in 1985.

A final problem to be addressed in the long term execution of this project is the preparation of the fossils once they reach the museum. It is a sad fact of life that money is more easily found to pay for the collection of specimens in the field than their preparation and study once the material has reached a museum. While Mrs. Thompson and Mrs. Kool have performed heroic feats of preparation, the sheer amount of material may make it difficult for them to keep up. In addition, Leslie Kool has been doing this work as a volunteer and cannot be expected to devote full time to it nor to continue in that capacity indefinitely. Ideally, a source of continuing funding should be found to hire Leslie to perform the work she now does gratis.

Postscript

Two things need to be mentioned although not directly related to the 1985 excavation at Dinosaur Cove.

First, on two weekends last Winter, volunteers from the Friends of the Museum of Victoria built a facility for processing fossils. Specifically, they constructed about 100 square metres of concrete pads on which rock from Dinosaur Cove and elsewhere can be allowed to weather for a period of time in order that fossils which would otherwise be unobtainable can be recovered. Furthermore, one of them, Mr. John Herman, has gone on to build a flying fox to bring the rock from the closest level a vehicle can reach down a hill to these concrete pads.

The people involved with the pouring of the concrete were the following:

Malcolm Carkeek

Craig Cleeland

Margaret Flattely

Chris Fountain

Janet Fountain

Peter Gonshor

John Herman

Richard Malcolm McKean

Wendey Moore

John Saul

Jeff Smith

John Smith

Frank Steuart

Michael Whitelaw

People who provided material support for this project were:

Noel Atkins

Barry Hawkins

Geoff McGivern

David Noonan

John St. Alban

Alan Sherlock

Richard Sund

Second, through the good offices of Mr. William Loads, Atlas Copco has presented the Department of Vertebrate Palaeontology with a COBRA 148 rock drill and breaker to further its field activities not only at Dinosaur Cove but elsewhere.

For this assistance, I am personally grateful to the individuals involved.

Reference Cited

Dettmann, M. E. and J. G. Douglas, 1976. Palaeontology, pp. 164-176, in Douglas, J. G. and J. A. Ferguson (eds.), **Geology of Victoria**, Geological Society of Australia Special Publication no. 5, pp. i-xi, 1-529.

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14 May 1985