FIELD WEEKEND, ISLE OF WIGHT, JULY 2005

Elizabeth Devon

This was a joint field weekend for our Society and for the Mole Valley Geological Society with whom we have been sharing our annual field weekends for the last three years. We met at Dinosaur Isle Museum in Yaverland (SZ 606846) in the evening of Friday 15th July having variously braved the crossing of the Solent. Here Trevor Price gave us some background geological information about the Isle of Wight, took us on a tour of the Museum describing its formation and development. We had fun playing with all the exhibits designed with children in mind and were seriously impressed with all the beautiful fossils on display. Much conservation work is carried out on finds from all over the Island at this Museum.

Background:

The rocks in the Isle of Wight give an almost continuous geological record from about 126 million years ago (Lower Cretaceous) to about 32 million years ago (Oligocene series of the Palaeogene (formerly Lower Tertiary). The oldest rocks proved beneath the island are marine sediments (Devonian) which were folded into mountain chains during the Variscan orogeny, about 280 million years ago. They were tightly folded and broken by long E-W fractures (that became spoon-shaped listric faults running out at depth to the south). One of these fractures runs beneath the centre of the island and controlled the position of the much later folding that produced the island's Chalk spine. In fact this fault has been active since the Permian.

126 million years ago, the island was covered by rivers, swamps and lakes inhabited by dinosaurs and early mammals. The Wealden deposits formed during these conditions. During the Permian, Jurassic and early Cretaceous, regional extension was occurring and the southern half of the island was part of a growth fault, with sediments infilling a gradually sinking valley to form a thick sediment pile trapping the remains of the dinosaurs, and all of the other associated animals and plants. However, by 90 million years ago, extension had halted and the whole area was beneath a clear, subtropical sea and soft chalk limestone was forming from the microscopic debris of algae and shells.

By 50 million years ago, the island was again above the sea and Eocene sands and muds were deposited in estuaries, swamps and shallow muddy seas inhabited by reptiles and mammals. Many species, including the dinosaurs, had suffered the K-T extinction event.

Once again the rocks were folded during the early phase of the Eo-Alpine orogeny in bursts from about 40 million years ago. Compression from the south uplifted the former southern basin forcing the chalk and overlying sediments into an assymetrical fold. Pressure was from the south and a great monocline, dipping north, and uplift of the land occurred in this area. The vertical limb of the Isle of Wight monocline runs W-E for a distance of about 80km from Lulworth in Dorset through the Isle of Wight from the Needles to Culver Cliff and then E beneath the Channel. It overlies the long fracture mentioned earlier. The fault continues across the Channel into France. The harder rocks in this almost vertical steep limb, the Upper Greensand and Chalk, form a sinuous spine of high ground from the Needles to Culver Cliff. The steep limb of the monocline is itself displaced by a hidden fracture in the deep basement rocks which causes the ridge to be displaced north from Shorwell to Newport.

On the south side of this ridge, the softer rocks of the Wealden, Lower Greensand and Gault form lower ground in the almost horizontal limb of the fold. To the north the soft Palaeogene sediments (Eocene and Oligocene), also in a flat-lying limb, give rise to low relief land.

During the glacials of the Pleistocene Ice Age, the last of which ended about 10,000 years ago, the Isle of Wight would have been similar to present-day Arctic Canada or Siberia. In this periglacial climate, the ground was frozen to depths of over 100m and heavy winter snows were followed by spring thaws which produced flash floods. These torrents of water eroded large quantities of the harder rocks and played a major part in shaping the present-day scenery. The most conspicuous erosion features are the deep, now mostly dry, valleys through the Chalk ridge - Freshwater, Newport and Sandown. These occurred along major offset faults in the chalk; dissolution of the chalk was easier where it had been pulverized by movements along the faults.

The Pleistocene gravels contain remains of pollen from tundra vegetation and rare bones, teeth and tusks of mammoth and woolly rhinoceros. During the warm interglacials elephant and hippopotamus roamed the temperate forests. Of course, at this time, the Isle of Wight was part of the mainland. *Homo sapiens* arrived in the area at the end of the last cold period, but many of their habitation sites in the Solent Valley were drowned by the rising sea, as global warming continued to melt the polar ice caps and the glaciers retreated. Neolithic remains have been found on higher ground, particularly on the Chalk downlands.

Succession from Yaverland to Culver Cliff from oldest to youngest rocks:-

Wealden	Wessex deposits (124-122Ma)
	Vectis Formation (122-120Ma)
Lwr Greensand	Atherfield Clay Formation
	Ferruginous Sands Formation
	Sandrock Beds
	Carstone
Gault Clay	
Upper Greensand	
Grey and White Chalk	

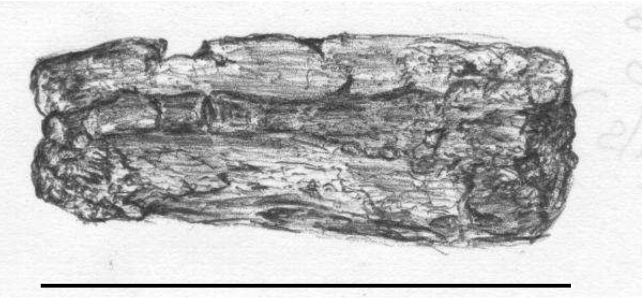
Saturday July 16th

Saturday morning saw us once again at the Museum but this time ready to walk along the coast from Yaverland NE towards Culver Cliff *(succession shown above).* Our guide for the day was Trevor Price, an expert local geologist and Community Learning Officer from Dinosaur Isle Museum.

We started by looking at the oldest rocks on the Isle of Wight, the Wessex Formation of the Wealden, (Lower Cretaceous, c.123Ma). We were standing on a fluvial floodplain with the sediment indicating hot, arid conditions and containing plant debris. Trevor told us that when this surface is clear of sand, in the spring, it is criss-crossed with footprints, a veritable trample zone, yielding prints from Iguanadon, Ankylosaur, probably Baryonyx and very large round prints which may be from a sauropod.

It was easy to imagine the inside bank of a Wealden river as we looked at the present cliff-line. A little further along we could see evidence for flood deposits on top of the channel. We investigated a silt pond where the sediment showed yellow staining indicating sulphur, resulting from a change to more oxidising conditions following the decay of the wood of pine trees which had floated into the pond. As we moved further on up the sequence, we could see white patches in the cliffs, apparently footprint casts. We then found one of these on the shore, although I doubt that any of us would have recognised it, if Trevor had not drawn the outline of an enormous footprint in the sand around the cast. The creature must have weighed 5 - 6 tonnes. To complete our investigation of the Wessex Formation, Trevor informed us that a pterosaur had been found here and that there were large freshwater ponds well stocked with fish and shellfish. We had just walked through about 2 million years of earth's history.

We now encountered rocks of the Vectis Formation (top of the Wealden). Storm beds at the top of the Vectis are packed with bone fragments. These were attacked by bacteria in reducing conditions ideal for the formation of iron pyrites. Much searching was carried out here, especially as we walked on to the Perna Bed which is the base of the Atherfield Clay (Lower Greensand). We did not spend too much time looking for the boundary between terrestrial/freshwater (Wealden) and marine (Lower Greensand) deposits as we would be looking for this particularly on Sunday in the SW of the island. Many specimens of fish scale and bone were collected including an excellent example of an Iguanadon rib, *(photograph 1).*



65mm

Photograph 1: part of Iguanadon rib, from a drawing by Margaret Hargrave who collected the specimen

The Ferruginous Sands, the next deposit, form huge cliffs here which are eroding rapidly. It is not a good idea to sunbathe beneath them! The sands pass upwards into estuarine and mudflat cycles of the Sandrock Formation. As we walked past it we noticed a considerable fault separating these yellow sands.

The last deposit of the Lower Greensand, the Carstone, is a basal lag sediment of the Gault. It represents the Selbornian transgression and is the beginning of the marine basin into which were deposited the Gault and then the Upper Greensand. Beyond the Gault we came to the Upper Greensand and then the Chalk, *(photograph 2).*

Photograph 2: View about 1km from Yaverland towards Culver Cliff, showing the succession from Lower Greensand through to Chalk

An interesting Pleistocene river channel was pointed out in the Upper Greensand *(photograph 3)* and Milankovitch cycles were clearly visible in the Chalk deposits. It was clear from a large V-shaped crumple zone that the Chalk had suffered much deformation.

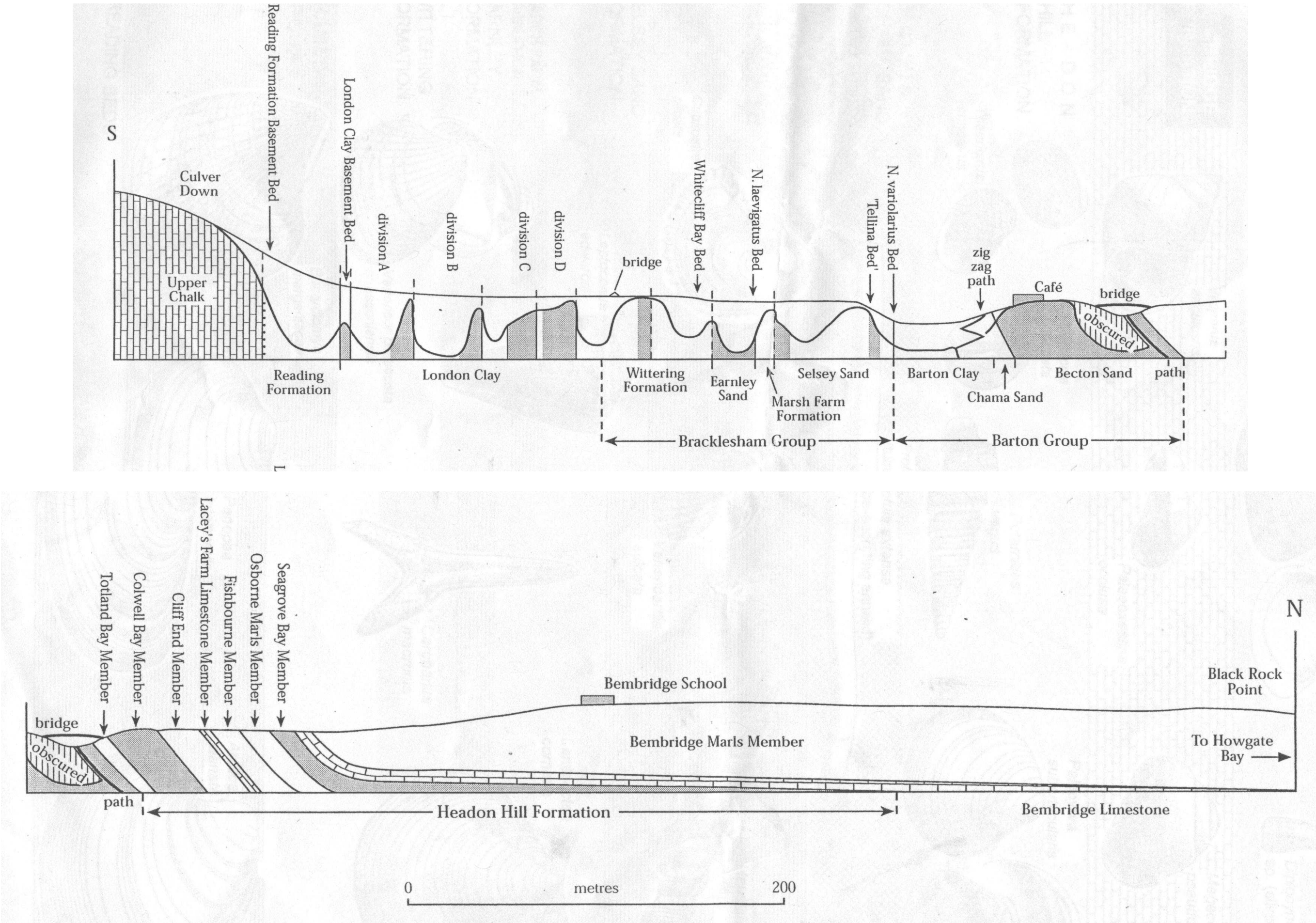


Diagram 1: Cliff Profile, Whitecliff Bay showing the distribution of Palaeogene strata (adapted from Daley and Insole, 1984)

Photograph 3: Pleistocene river channel cut into the Upper Greensand. The Chalk is on the right of the photo.

After a leisurely lunch at Yaverland, we set off for Whitecliff Bay (SZ 641862) with Martin Munt leading the party. Martin is Curator of Geology at Dinosaur Isle Museum and is an expert on this Palaeogene section. According to Trevor, he also knows 'everything there is to know' about gastropods (snails!).

The geology in Whitecliff Bay is very exciting as it has the most extensive sequence of Palaeogene (Lower Tertiary) sediments, Eocene and Oligocene, in western Europe. There are 550 metres of steeply dipping rocks over a horizontal distance of about 1km and there are 15 stratotypes here, *(diagram 1)*. All the rocks here were deposited in cyclothems, as sea level fluctuated, when the main fault beneath the island, mentioned earlier, was particularly active.

We walked to the SW of the bay to start looking at the oldest beds of the sequence. The first deposit after the eroded Chalk is the Lambeth Group* *(Reading Formation and shown as such in diagram 1)*. This deposit is a bit like the Wealden - land deposition and reworked soil.

We then looked at the contact *(Photograph 4)* between the Lambeth Group and the Thames Group* *(London Clay and shown as such in diagram 1)*. In some of the London Clay deposits, we noticed tiny clasts of clay with glauconite which is indicative of shallow, marine conditions. There is also a very good shell bed. As we progressed slowly along the beach we came to a nearly vertical deltaic deposit. The two clear sequences of mud/sand then mud/sand in the London Clay have been demonstrated to be the distal end of two north-trending deltas. The mud was laid down first,

*(*Higher level names allocated to higher stratigraphic units)*

Photograph 4: Contact between Lambeth and Thames Groups

then as the delta moved further north the sand was laid down over it. The two sands form prominent ridges in the cliff line, whilst the dark grey mud collapses down onto the beach.

As we reached the top of Division D *(diagram 1),* we saw jarosite, (potassium iron sulphate hydroxide), a yellow mineral caused by bacterial dissolution of pyrite. It is a secondary mineral that forms under conditions of weathering in arid climates. It occurred in patches over these almost vertical beds which also showed heterolithics, i.e. thinly interbedded sand and mud characteristic of a tidal area or of fluctuating sea level, *(photograph 5).*

Photograph 5: Top of Division D, Whitecliff Bay Sands, showing heterolithics and jarosite

Whitecliff Bay at this time was on the northern edge of a marine basin which extended down to the Mediterranean. The climate was hot and mostly arid with subaerial weathering. Sea level was fluctuating and this resulted in hypersaline deposits caused by evaporation. This is surely geology at its best - using the evidence to determine past environments.

By the time we had reached the top of the Earnley Sand *(diagram 1)*, this area was fully marine as indicated by numerous fossils including Nummulites, gastropods, like Turritella and many bivalves. There are two species of Nummulites together here in about 1m of rock. These deposits are very important because they represent the Eocene thermal maximum. Average global temperatures may have reached 26°C (about 14°C is the average today). The deposits indicate that the sea was still fluctuating as the marine sediments give way quite quickly to marshy deposits and then back to marine. A pebble bed indicates the beginning of the Selsey sandstone and an intertidal environment. The sediments are very fossiliferous with many of the finds showing signs of having been rolled by the tides.

Near the path, marked on the diagram as at the top of the Barton Group, marine conditions revert to freshwater in the late Eocene, although there is evidence of marine incursions. In the Colwell Bay Member, there are large concretions representing enormous mangrove-type roots, *(photograph 6).*

Photograph 6: Mangrove-type root in concretion in the Colwyn Bay Member

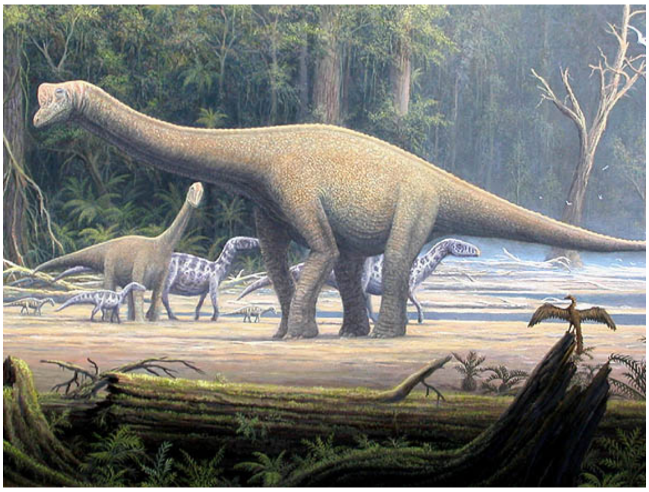
Further on, in the Cliff End Member, however, there is only evidence of the shallow-burrowing bivalve, *Venus*. This single species assemblage, high numbers, low diversity, is a clear indication of stress, probably caused by a change of conditions resulting from renewed compression of the strata.

We walked on until the rocks started to flatten out and we could see the Bembridge Limestone. This is a massive limestone and has been used extensively for building on the island. On top of this we could see a green layer, the Bembridge Marls. This is the beginning of the Oligocene, c.32Ma) and the beginning of marked global cooling. The first Arctic ice formed now. However, it was not really cold here as the Bembridge Marls were deposited in similar conditions to the Florida Everglades today!

It had been a fantastic day - stunning geology and glorious weather. We had travelled through c.94 million years of time from the subtropical age of the great dinosaurs to the beginnings of global cooling that led eventually to our current Ice Age. We were all very grateful to Trevor and Martin for sharing their vast expertise of this area with us.

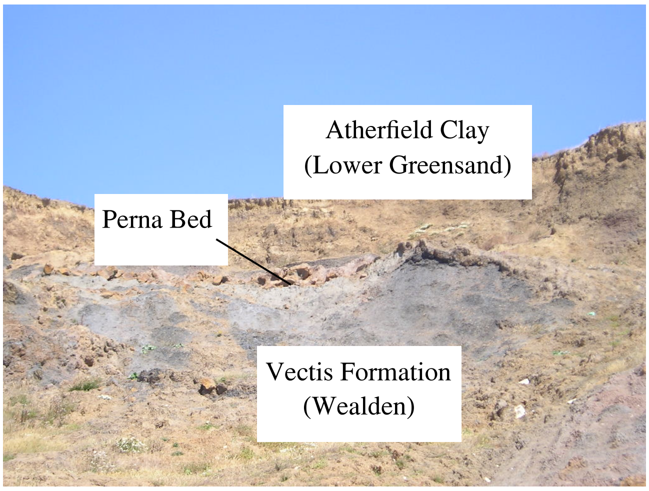
Sunday July 17th

This morning we travelled to Dinosaur Farm Museum, on the SW of the island (SZ 441810), overlooking Brighstone Bay, to meet its manager, Paul Newton. Paul is also Secretary of the Geology Society of the Isle of Wight. Paul gave us an introductory talk on how the Museum was started, plus a bit on the finds made of dinosaurs and other fossils on the island (especially those found on the Farm's land). Paul admitted to knowing much more about marine palaeontology than he does about dinosaurs. We then toured the Museum which consists of 3 rooms of displays. The first is the 'entry room' with shop, conservation work table plus some display cabinets. The second room is the main dinosaur barn, with themed display cases and the third is a smaller room with cases full of non-dinosaur fossils such as ammonites, lobsters, brachiopods, bivalves etc. from Cretaceous and Palaeogene island deposits. Paul told us about the fossil find from the biggest dinosaur so far discovered in the UK. It is a single neck bone from a Sauropod. Physical features suggest this IOW creature had similarities to Brachiosaurus and Sauroposeidon, *(photograph 7)*. It was found in the Wealden Wessex Formation and dates from 125 - 130 Ma. It was found in the Wealden outcrop in Brighstone Bay.



Photograph 7: Sauropod with juveniles and Iguanadon.
(We were walking on this surface
in the Wealden Wessex Formation!)

We then walked down to the beach at Shepherd's Chine (SZ 445798) and made our way slowly SE towards Atherfield Point. At first we were walking over the Wessex Formation of the Wealden Beds but quickly came to the Vectis Formation. Here we found many pyritised fish remains and shell beds, indicating the incursion of the sea over the flood plains. Shark spines, pterosaur remains and crocodile teeth have been found here too. At the top of the Wealden we saw an inconsistent grit bed which formed the very base of the Lower Greensand Perna Bed. This represents a return to fully marine conditions, *(photograph 7)*.



Photograph 7: Wealden / Lower Greensand Junction

We walked as far as Atherfield Point where the Perna Beds form a reef out to sea. Some of the corals here were spectacular. There was also much pyrite sand. Looking round into Chale Bay we could see the outcrops of the Upper and Lower Lobster Beds which have yielded beautiful fossils, examples of which we had seen in Dinosaur Farm Museum. After saying goodbye and a big thank you to Paul Newton, our party split up, with some of us making our way back while others set off to explore the Lobster Beds.

Once again we had all enjoyed an excellent field weekend with our friends from the Mole Valley Society. We had been extremely fortunate to have gained so much geological knowledge from our three expert leaders. I think we all hope to visit the Isle of Wight with Dinosaur Isle and Dinosaur Farm Museums again in the future.

Further Information:
www.dinosaurisle.com
www.isleofwight.com/dinosaurfarm

Thanks to Trevor Price for reading the article and for his helpful suggestions.