# *TEMPORARY EXPOSURE EXAMINED BY THE BATH GEOLOGICAL SOCIETY DURING RECENT CONSTRUCTION OF THE SEMINGTON BYPASS A350 (WILTSHIRE)*

*Alan Saxon*

Visits were arranged by Tom Ralph liaising with Ringway Parkman's site engineer for two consecutive Sundays, 30th September and again on 5th October 2003. Other members present included David Workman, Isobel Geddes, Robin Hervin, Jenny Martin, Linda Drummond-Harris, Iain Brown and myself.

I first heard about this new road scheme whilst listening to the radio one very wet Saturday morning in February as I battled through heavy traffic in Chippenham. I can tell you it lifted my flagging spirits immediately. I had read about this area in the Directory of British Fossiliferous Localities; certainly Seend was close to this site and quoted as "Jurassic Corallian beds (Lower Calcareous Grit) a source of many fine ammonites in the national collection and in the Devizes Museum". Could we be in the Corallian or perhaps the famous Kellaway beds, or was it the Oxford Clay? I wasn't sure but something told me it had to be followed up.

The first phase of the scheme was about to commence. It was to insert a temporary loop in the Kennet & Avon canal, thus allowing boat traffic to proceed unimpeded whilst an aqueduct was constructed to carry the canal across the route surveyed for the new A350 bypass.

I made initial contact with the Kennet & Avon canal engineers at Devizes. They were very helpful and explained that the canal loop would in all probability be too shallow to reveal anything geologically worthwhile but that a cutting 3-5 metres deep taking the road under the canal would be worth a visit. They also pointed out that I needed to talk to the contractor not to them and at that point in time it was still out to tender with a final decision pending shortly. In any event the work would start in the coming summer.

I searched the local media and made several visits to the site myself, hoping to see some progress and report back. Yes, the temporary loop was in place and remains of the old canal bed relegated to several ponds but there was no sign of any serious digging. Summer came and went and autumn turned to winter. Why had they not started? What was going on? I eventually found out that although the go-ahead for the road scheme was authorised, there was a hold up of some kind due to government red tape.

Shortly afterwards, during a committee meeting Robin Hervin told us about his friend Tom Ralph, also a member of our society and a professional geologist working for Ringway Parkman. What a scoop! Tom was approached and he kindly volunteered to take over. If anyone could get us in, he was our best hope. As winter gave way to spring we began to hear from Tom that work was due to commence soon, and he was putting out feelers. We were cautioned that although it looked promising, nothing was guaranteed. The site engineer would have to decide if the health and safety risk was acceptable. Well, we now know that he was persuaded and this resulted in two very interesting field trips and I would like to take this opportunity to thank Tom on behalf of the society.

### First Field Trip Sunday 29th September

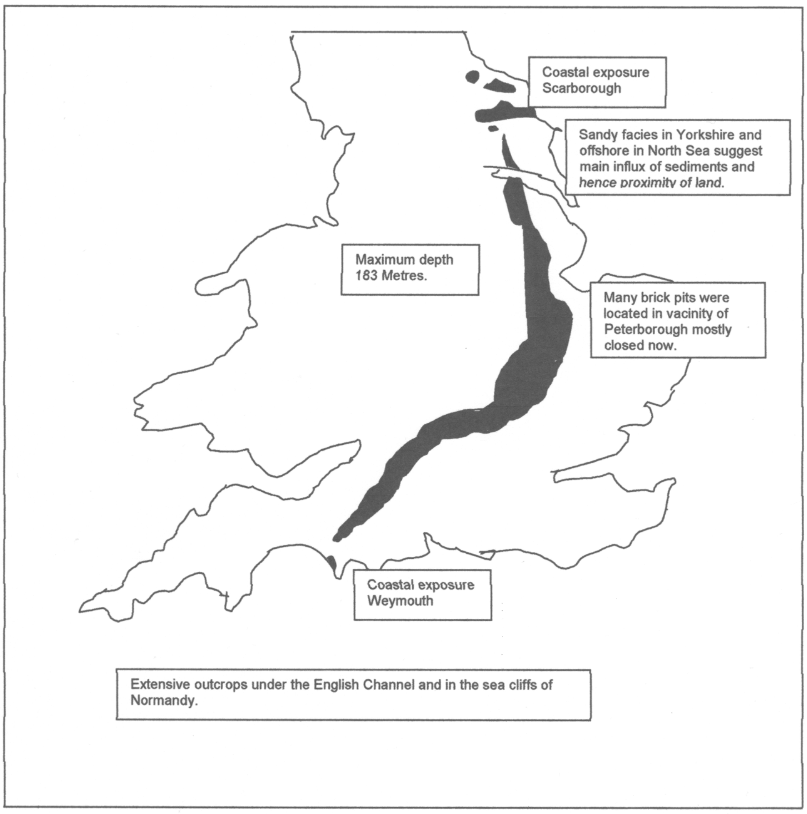
The meeting point was just beyond the new Avon Rubber factory off the A350 adjacent to a collection of temporary site offices. It was a pleasantly warm sunny autumn day at the end of the best summer I can remember for many years. After a short pause for possible late-comers we moved off again by car back on to the A350. We drove a short distance south and just before the hump-back bridge over the canal, we turned left though a gap in the hedge and along a stone track built by the contractors, stopping by more temporary buildings adjacent to the aqueduct site.

The surroundings had certainly changed considerably since I had last approached from the towpath many months before. Two parallel rows of concrete reinforced piles had been sunk at right angles to the old canal bed and extended some distance either side. These were the supporting structures to carry the aqueduct and hold back the embankment; the distance between these two rows represented the span. Straddling the piles, a substantial chunk of steel reinforced concrete lay across the top, this being the bed of the aqueduct, and, immediately below this, the blue-grey clay.

In other words, the structure was resting firmly on the ground although not depending on it for any support. Between our viewpoint and the aqueduct a deep hole resembling a huge bomb crater had been carved out of the ground. Tom explained that within the next few days the contractors would begin to dig towards the aqueduct, slowly excavating all the clay from underneath to make the new road- way.

As we paused before descending into the exposure I asked the question, were we definitely in the Oxford Clay? *(Refer to map on the next page showing the geographical distribution of the Oxford Clay in England)*. I was secretly hoping that it might be the Kellaways Beds as I had heard about the superbly preserved ammonites that could be found in this deposit. From the rough geological sketches that I had to go on, it at least seemed possible. However

Geographical distribution of the Oxford Clay




Robin told me of an ammonite he found at Trowbridge and that it was a zone fossil for the Kellaways and some 3 miles to the west of our present position. As I looked east along the canal route I could clearly see the flat Avon Valley gives way to the Corallian Escarpment at Seend and, knowing the Oxford Clay lay between these two formations, I had to let this wish go. Anyway, I thought inwardly this section is famous for its abundant fossils so let's see what we can turn up.

We descended carefully to the lowest point and began searching. We worked across and up the exposure wherever possible, but it was too steep in some places. Probably the most common fossil encountered was the bivalve *Gryphaea dilobotes*. Interestingly, we found large numbers packed closely together in shell-beds. Tantalising large body chambers of ammonites were also discovered thought to be *Perisphinctes*. Closer examination revealed an evenly worn surface on both sides and often worm casts and bivalves were attached to the ammonites. The erosion of the shell surface suggested that they had been exposed on the sea floor for some time and become suitable habitats for others to exploit and also that sediment deposition would appear to have been very slow at this time. Fragments of, and sometimes complete, Belemnites were also much in evidence and we were able to identify *Cylindroteuthis puzosiana*. We also found fossilised wood to be abundant. After a very successful trip we went our own ways, eager to clean and examine our finds and already looking forward to the promise of a second visit in the near future.

## Second field trip Sunday 5th October 2003

We met again as on the previous trip and transferred to the aqueduct site approaching from the opposite side via the A361 Devizes road. Tom had heard that a large ammonite in a limestone boulder had been put on one side destined for a local school. We would all like to see this, but where exactly was it? He didn't know.

The route of the new bypass could clearly be seen as a swathe of blue-grey clay intersecting the A361. Looking south in the direction of Steeple Ashton it soon disappeared round a bend, its sides banked up. Glancing north, it ran in a straight line for almost half a mile up to the edge of the canal aqueduct, stopping just short of it. We parked and set off towards the canal. Iain soon found a complete ammonite in good condition about 70mm diameter, later thought to be *Quenstedtoceras,* species unidentified. *(See photograph 1).* As we progressed further, we encountered the steel shuttering of the new bridge crossing Semington Brook and a temporary roadway which dipped down to our right, crossing a Bailey bridge to allow construction traffic access beyond.

*Photograph 1: Quenstedtoceras lamberti*
*(found by Iain Brown)*

Next, we met several mineral collectors searching for selenite (gypsum) crystals and stopped for a chat. They explained that Wiltshire has the finest crystals anywhere in the Oxford Clay "of course" they said, "they can be found all over the country, but not as good". They proudly displayed their finds to us.

As we passed just beyond the bridge, we encountered some large limestone boulders and evidence of yet more ammonites, which were a chalky white colour and embedded in extremely hard, grey, unyielding rock. We now fanned out as the main excavated area lay before us. We could see about 5 metres of clay rising up in two terraces with a wide accessible platform between them. We observed two thin limestone bands some distance apart and packed with shell remains.

We were soon finding fossils and able to add many new specimen types to our growing collection. These included the rather attractive bivalve *Myophorella,* species unidentified. Several of us picked up and then discarded a chunk of ammonite, that if complete, would have been about 300mm across. I dug out two sections of a similarly large ammonite from the bank about one metre up from the first level. Most of the centre whorls were missing but it was impressive none the less, and you could also clearly see the fresh impression left in the clay from the missing half. I carried these two pieces across to my bag, passing again the same discarded segment as before and wondered if they might belong together? No, it was surely too much of a coincidence. But as the separate parts converged I couldn't believe it! I now had three out of four parts. Well, I pondered, and drew in a deep breath. It would be great to find the last piece of this fossil jigsaw. What about the area immediately below where I had dug out the two sections? I had already had a scout around and found nothing. I dived over there, buzzing with anticipation, scrabbled around and found what proved to be the missing piece and needless to say was ecstatic. This was thought to be a Perisphinctid, *Proplanulites koenigi, photograph 2.*

*Photograph 2: Proplanulites koenigi*

Other ammonites found included another Perisphinctid 150mm across, two complete *Cadoceras (durum) enodatum*, two good largely complete *Sigaloceras calloviense* crushed, and one fragment uncrushed, (see *photograph 3)* a complete possibly *Kosmoceras (lobokosmokeras) phaeinum* crushed wafer-thin in shale and still in its original mother of pearl, and sadly too fragile to take.

I was the last to leave and began the long slog back towards the car. My bag was getting heavier each step of the way but my spirits were sky high and I was delighted

*Photograph 3: Sigaloceras calloviense*

with my finds. To one side of the roadway lay a large limestone boulder with an "x" scribed on to it and the edge of an ammonite protruding either side and measuring about 60 centimetres. This was probably the one Tom had told us about before. What an afternoon it had been; one that we won't forget for a long time.

## A Description of the Exposure at Semington

We studied perhaps 4 metres of sediments. The most striking features were two thin limestone bands some distance apart. We also observed lines of septarian nodules of various sizes; these appeared to have calcite veins and some contained geodes. As we scanned the strata vertically we found it to be punctuated periodically with shell bands. Moving away from the worked face and back to Semington Brook we encountered large limestone concretions many showing evidence of ammonites some very large up to a metre across. The fossils were white in appearance and left a chalk-like dust on the skin. After consulting the books, this substance was thought to be aragonite, a typical form of fossilisation in the Lower Oxford Clay. Selenite crystals were much in evidence, particularly in the highest levels close to the surface. Many of the fossils encountered were picked up loose in clay re-worked by earth-moving equipment and therefore we can only guess as to their true position in the strata.

## What can we ascertain about this marine environment by visual observation?

The absence of any sandy facies rules out a high energy near-shore environment. The fossil evidence also supported this when we found large colonies of relatively undamaged *Gryphaea.*

Could it then have been a muddy estuary? Normally, we could look for evidence of cross-bedding to show strong currents but unfortunately clay does not easily reveal these structures. So how can we rule in or rule out an estuary? I would expect continually shifting mud or sandbanks in a tidal estuary. If we consider the state of preservation of larger ammonites found in the clay strata as opposed to those in concretions, first of all they would sink rapidly

| STAGE | | ZONE | SUB ZONE | STRATA |
|---|---|---|---|---|
| OXFORDIAN | LOWER | CARDOCERAS CORDATUM | C. CORDATUM | **UPPER OXFORD CLAY** |
| | | | C. COSTICARDIA | |
| | | | C. BUKOWASKII | |
| | | CARDOCERAS MARIAE | C.PRAECORDATUM | |
| | | | C.SCARBURGENSE | |
| CALLOVIAN | UPPER | QUENSTEDTOCERAS LAMBERTI | Q.LAMBERTI | **MIDDLE OXFORD CLAY** |
| | | | Q.HENRICI | |
| | | PELTOCERAS ATHLETA | K.SPINOSUM | |
| | | | K.PRONIAE | |
| | | | K.PHAEINIUM | **LOWER OXFORD CLAY** |
| | MIDDLE | ERYMNOCERAS CORONATUM | K.GROSSOUVREI | |
| | | | K.OBDUCTUM | |
| | | KOSMOCERAS JASON | K.JASON | |
| | | | K.MEDIA | |
| | LOWER | SIGALOCERAS CALLOVIENSE | S.ENODATUM | |
| | | | S.CALLOVIENSE | **KELLAWAYS BEDS** |
| | | PROPLANULITES KOENIGI | K.GALILAEI | |
| | | | K.CURTILOBUS | |
| | | | K.GOWERIANUS | |
| | | MACROCEPHALITES HERVEYI | M.KAMPTUS | **CLAYTON CLAY** |
| | | | M.TEREBRATUS | |
| | | | K.KEPPLERI | **ABBOTSBURY CORNBRASH** |

*Table 1*

into soft mud and so be preserved in pristine condition but instead they show surface erosion.

Fossils found in areas subject to tidal currents often have one side badly eroded and the other in good condition. Our ammonites showed prolonged steady erosion on both sides. Another clue again with the large ammonite *Perisphinctes* was the evidence of bivalve attachment. If a bivalve attached itself to a large ammonite shell lying on the seabed it must have formed a useful anchor as a rock substitute. Therefore it must have been exposed on the surface for some time to be colonised in such a way and not rolled about. From these observations it would appear that we could reasonably project an off-shore environment with fairly firm seabed conditions, gentle currents and the very slow accumulation of sediments on the sea floor.

Fossil wood was abundant, so we do know that land could not be too far away and it had vegetation. What about the limestone bands? Some theories suggest shallow seas at this time, others speculate heavy rainfall causing excessive run off from land.

## How could we use the fossils found to identify the strata we were examining?

The consensus amongst the party before collecting fossils suggested that we were either in the Middle or the Upper Oxford Clay. Now that our collection has been identified, we should be able work out its age by a bit of detective work. To do this we will look in detail at the ammonite zones. It was the famous William Smith born in 1769 who stated that the relative age of the rocks could be identified by the fossils found in them and we can now apply this technique to our specimens and see what happens.

So many different ammonites evolved and then became extinct over a relatively short time span that they are ideally suited to predict the order and relative age of sediments in Jurassic rocks. Their abundance in a specific layer of the strata allows us to assign a name to that layer. However, accurate identification is critically important and it's not always as easy as it might at first appear. When we have assigned all the fossils to zones this should enable us to identify the geological section examined.

## Ammonite specimens found:

*see table 1 for relative positions in strata*

1. *Kosmoceras lobokosmokeras* - Athleta Zone, Phaeinum sub zone.
2. *Cardoceras durum* - Calloviense zone, Enodatum sub zone (occurs occasionally).
3. *Sigaloceras calloviense* - Calloviense zone, Enodatum sub zone
4. *Perisphinctid proplanulites koenigi* - Calloviense zone.
5. *Quenstedtoceras sp?* - Lamberti or Henrici zone (abundant).

Items 1, 2, and 3, are all in the Lower Oxford Clay.
Item 4 belongs to the Kellaways formation close to the bottom of the Lower Oxford Clay so it all fits so far. However item 5 looks out of place, for if we have correctly identified it, then it belongs in the top of the Middle Oxford Clay. We identified two other specimens and found that they also fitted the emerging picture. Belemnite *Cylindroteuthis pusoziana* - middle Callovian and the bivalve *Gryphaea dilobotis* - Calloviense zone.

Out of 7 specimens, the spread of zones falls convincingly into the Lower Oxford to Kellaways Clay with the one exception described above. *Quenstedtoceras* from *table 1* can only belong in one of two adjacent zones of the Middle Oxford Clay. How could this be? What about a fault zone? This could result in fossil finds that were displaced by a considerable time scale to be found close by all the others that slotted so nicely into adjacent zones.

In desperation, I consulted the last book in my modest library, hoping for a break. I opened *'Hidden Depths; Wiltshire's Geology and Landscapes'* by Isobel Geddes, and turning to page 96 came across a geological map and found the Trowbridge fault. I don't have any detailed maps and so 'phoned Isobel Geddes, asking, "Does the Trowbridge fault extend to Semington and, if so, is it anywhere near the site of the aqueduct?" I got a "yes" to both questions. "Is the fault in the vicinity of the Semington Brook and could this result in the Lower Oxford Clay emerging at the surface against the Middle Oxford Clay?" Again I got a "yes" to both questions.

So, we have an upthrow to the North and West of Semington Brook displacing the Oxford Clay and allowing the Lower Oxford Clay and Kellaways formation to re-emerge at the surface. Interestingly enough, the ammonite *Quenstedoceras* found by Iain Brown was the only fossil to my knowledge picked up south of the Semington Brook. We don't know how it arrived there but it makes sense to find it where he did.

## Conclusions

We have, I believe, collected enough evidence to support the assertion that this temporary exposure appears to be in the Lower Oxford/Kellaways Clay. However expert identification of the fossil finds would be required to confirm this. I have drawn these tentative conclusions based only on amateur observations and am only too aware that some ammonites are notoriously difficult to identify for the beginner.

The combination of civil engineering and the proximity of the Trowbridge fault may or may not have conspired to confuse the picture. So whether due to tectonic disturbance at the fault zone or excavation or wrong identification we have one ammonite that appears to belongs to the Middle Oxford Clay.

I would like to draw the reader's attention to the ammonites collected by Sue Cowdry and Adrian Brain of the Russell Society listed at the end of the article. Alan Bentley, who is an expert on the Lower Oxford Clay, has identified these. My understanding from conversations with Sue is that his evidence gathered thus far suggests the exposure to be the Kellaways formation.

## What the experts say about seabed conditions

The Oxford Clay is a succession of mud rocks with intermittent concretionary carbonate horizons that lie above the mainly sandy Kellaway formations and is overlain by the Corallian beds.

The benthos (bottom living fauna) provides our best evidence for conditions on the sea floor. There is a clear difference between the faunas of soft mud bottoms (most of the Lower Oxford Clay) and stiff mud bottoms (most of the Middle and Upper Oxford Clay) and of shell beds.

The *Gryphaea* shell beds of the lower part of the Lower Oxford Clay form distinct habitats. These bivalves require a firm sea floor. Concentrations of *Gryphaea* are much reduced throughout the rest of the Lower Oxford Clay and so we can conclude that the seabed began as stiff mud and progressed to soft mud conditions during this period

*'Fossils of the Oxford Clay'* edited by David M. Martill & John D. Hudson.

Using evidence provided by the experts lets go back and re-consider what we thought about the large ammonite *Proplanulites* with evidence of bivalve attachment. When we look at its assigned zone we find that it lies in the Calloviense zone just below the bottom of the Lower Oxford Clay when sea bed conditions were firm. We can now also understand why certain areas within the strata may favour *Gryphaea* colonies, again firm seabed conditions must have prevailed and why certain other areas show an absence of such colonies.

Environmental conditions occurred at certain times in the Lower Oxford Clay that resulted in rapid increases in sediment fallout on the seabed. This has allowed complete burial of large marine reptiles before they could become scavenged and many complete articulated specimens bear witness to these events. Such a rapid deluge must have been catastrophic for *Gryphaea* colonies and thus, when we find such a colony lying close together, these are probably death assemblages.

With regard to the abundance of drift wood and the proximity of the coastline, our best evidence comes from clay pits in the Peterborough area where large concentrations of driftwood have been found along with the remains of eight terrestrial dinosaurs. The assumption is that the bloated decaying bodies were carried out from land nearby and later sank. However, to find sandy facies we have to move up to the Yorkshire coast or well out into the North sea.

## A swim through the Wiltshire countryside in Mid-Jurassic times

If we could travel back in time and felt brave enough or daft enough to swim in these tropical seas what would we find? A wide shallow sea perhaps a few tens of metres in depth and a pleasant water temperature of around 20 degrees centigrade. Sound okay so far? I've just popped my head up at Semington and I can see a Pterosaur bobbing up and down on the swell but no sign of the coastline from here.

Let's take a dive to the sea floor; it's not too far down and the strong sunlight should improve visibility down there today. I'm at the bottom now, I'm running my fingers through the silt and it's a fine-grained organic rich sediment. The top few centimetres are soft but it's much firmer just beneath. Here and there are colonies of *Gryphaea* reclining on their backs sifting away and I can also see many gastropods quietly grazing. Although the sea floor is well populated, there is not much diversity.

Swimming up a bit, there's a shoal of Belemnites; they move as one in short bursts of speed and are suddenly almost out of sight - perhaps I got too close. I can see many different ammonites dotted about at various levels in the water column. Looking downwards again to the seabed I see a shark cruise slowly by. Now let's take a look at the top end of the food chain. There goes an Ichthyosaur chasing a shoal of fish. He eye-balled me for a split second as he sped by. We should find Plesiosaurs and marine crocodiles down here but thankfully I've not seen any so far and hope they don't see me. Time to return to the present before I end up as someone's dinner.

## The Oxford Clay as an Economic Resource

In the not too distant past, many towns had their own brick-works and various types of clay have been utilised. I know of places that use Carboniferous, Gault and Lias clays instead. However the Oxford Clay is by far the best. Let's hear why from the experts.

In particular, the Lower Oxford Clay supports the largest brick-making industry in the world. It has a high content of organic matter, averaging 5%, high calorific value and low combustion temperature. This means the bricks are virtually self-firing and need only the addition of small quantities of low-grade coal to maintain sufficient temperature. The firing temperature of 1000 degrees centigrade needed for other bricks is not required. Other favourable qualities include low water content, around 20%, giving the unfired bricks strength and reducing heating costs, and a calcium carbonate content of 5-15% giving strength in firing.

## Bibliography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During the writing of this article I was contacted by Sue Cowdry, a member of the Russell Society. She has been mainly interested in the minerals found at Semington but also collected a number of fossils. Her ammonites were identified by Alan Bentley. Sue heard, via Isobel Geddes, that I was writing an article and was trying, like her, to identify the exposure.

She very kindly sent a copy of all the fossils found and a very informative article she wrote on the minerals at this site. I thought our society would be interested in this and with her permission have arranged for her work to be included in this issue of the Journal.

## List of fossils collected at the Semington Bypass by Sue Cowdry and Adrian Brain

### Ammonites identified by Alan Bentley

**Ammonites**

1. Perisphinctid *Proplanulites (koenigi)*
2. *Kepplerites tricophoserous*
3. *Parapataserus* un-coiled ammonite, about 7mm across, in part of a broken septarian nodule.
4. *Pleurocephalites* sandy coloured thought to belong to the Cornbrash/Kellaways boundary.

Impressions of ammonites in clay from aqueduct area - very many, all fragile, fine ribbed appearance, mostly 30-40 mm across.

**Bivalves**

1. *Trigonia incurva ( Myophorella incurva)*
2. *Trigonia clavellate (Myophorella clavellata)*
3. *Pleurmya aldivini (myacites recurvum)*
4. *Pholadomya* (ridged)