# Hastings & District Geological Society Journal

Founded 1992

Hastings and District Geological Society
affiliated to the Geologists' Association

President
Professor David Price, UCL

Cliff section at Cliff End, near Pett, east of Hastings

Volume 12 December 2006

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**Geologists' Association Website -** http://www.geologist.demon.co.uk

Cover picture: Cliff section at Cliff End, near Pett, east of Hastings - photo: Peter Austen

If you have any news or reports that may be of interest to members of our society, please let me know, and I will try to include them in the next issue of the Journal. Deadline for copy for the 2007 Journal is the October meeting, **21st October 2007**.
Please contact Peter Austen on: tel: 01323 899237 or e-mail: PJAusten@ukgateway.net



**Taxonomic/Nomenclatural Disclaimer** - This publication is not deemed to be valid for taxonomic/nomenclatural purposes.

# HASTINGS & DISTRICT GEOLOGICAL SOCIETY

## Minutes of the A.G.M. - 11th December 2005

The Meeting was declared open at 2.40 p.m. by the Chairman, Ken Brooks. There were thirty-five members present.

1) **Apologies:** Were received from:
Peter Heald, Dale & Glenda Smith, and Tracey Schultz.

2) **New Members:** Ken welcomed new members Annette Maloney, John Betts and Ron Elverson.

3) **Minutes of the last A.G.M.:** Ken quickly read through these. Their acceptance was proposed by Tony Standen and seconded by Geoff Bennett, and a show of hands indicated that they were unanimously accepted. Copies of the Minutes were available to be read.

4) **Chairman's report:**

**a) 2005 Programme:** Ken summarised the year's activities:

**Lectures by visiting speakers:**
***'An Isotopic Tour of the Solar System'*** by Dr. Eta Mullane
***'The Origin of Land Plants'*** by Dr. Paul Kenrick
***'Bulverhythe Sea Defences'*** by Stuart Meakins
***'Chalk: the Record of Life & Death in a Hothouse Ocean'*** by Dr. Ian Jarvis

**Members' Day talks:**
***'Wealden Sharks'*** by John Evans

**Field Trips:**
New Year's Day Walk
Maidstone Museum
Barbecue Party
Storrington Field Trip
Smokejacks Brickworks Field Trip
Natural History Museum Field Trip

Ken explained how we had been let down on two occasions this year. He said the first occasion was ***'Volcanic Disasters: Past Present & Future'*** by Prof. Bill McGuire, who had been delayed on the underground and had not arrived in Hastings until after we had met three trains from London. He said that Bill McGuire was most apologetic and had agreed to come down again to give the lecture in 2006.
The second occasion was the visit to UCL. He said that Prof. David Price had had to cancel our visit at the last minute for personal reasons, but had agreed to arrange another visit in 2006. Ken also said that as it had been too late to cancel the coach to London, he had arranged for all those who had booked for the trip to go to the Natural History Museum instead.
Ken also thanked Trevor and Fiona Devon for hosting an excellent barbecue party and mineral display and said that it had been such a success that it would be repeated in next year's programme.

**b) 2006 Programme:** Copies were handed out to all members present. Those unable to attend would be receiving their copies with the next letter to members. Ken said how it was becoming more and more difficult to find new speakers. He then gave a brief résume of next year's lectures:

*'Dinosaurs of Southern England - Old and New'* - by Darren Naish
*'A Hastings Crocodile: It's Collection and Preparation'* - by Scott Moore-Fay
*'Finding Minerals of the World'* - by Dr. Trevor Devon

*'Volcanic Disasters: Past, Present & Future'* - by Prof. Bill McGuire
*Presidential Lecture* - by Prof. David Price

He said that there would be one Members' Day talk this year:
*'American Creationism and Intelligent Design'* - by Geoff Bennett

The 'outings' for 2006 would be:
New Year's Day walk at Fairlight
Field trip to Sheppey
Visit to the Booth Museum, Brighton, with John Cooper
Visit to UCL with Prof. David Price
Barbecue Party with Trevor & Fiona Devon
Field trip to Folkestone

Ken also said that in response to members' queries about field trips to France he had arranged for anyone interested to join Steve Perkins' group at Wimereux for the weekend of 24th - 26th March 2006, but that members would have to make their own accommodation arrangements - please contact Ken for further details.

**c) H.D.G.S. website:** Ken said that our website was now up and running thanks to Trevor Devon, that the address was **www.hastingsgeolsoc.org.uk** and that this would now be on all letterheads together with the e-mail address. Trevor said that he would now be updating the site with the 2006 programme. Any interesting items from members were always required for the site.

5) **Treasurer's report:**

Diana had typed up Norman Farmer's *Statement of Income & Expenditure for the Year Ending 31st December 2005* which was handed out to members. Ken briefly ran through the items, mentioning that the balance was down this year, mainly because of expenditure on sound equipment for the video and for the funding of the barbecue.

6) **Election of the Committee:**

Colin Parsons suggested that someone should propose that the Committee be re-elected *en masse*. This was proposed by Barbara Young, seconded by Joyce Austen and was unanimously carried. Ken said that Trevor Devon had been co-opted on to the Committee during the year, Gordon Elder had resigned as Journal editor but would remain on the Committee, and Roger Blaker had resigned as Librarian. The Committee was said to be as follows:

| **2005** | **2006** |
|---|---|
| **Chairman** | |
| Ken Brooks | Ken Brooks |
| **Treasurer** | |
| Norman Farmer | Norman Farmer |
| **Secretary** | |
| Diana Williams | Diana Williams |
| **Journal editor** | |
| Gordon Elder | |
| **Librarian** | |
| Roger Blaker | |

| **Other Officers** | |
|---|---|
| 1. | Gordon Elder |
| 2. David Dewhirst | David Dewhirst |
| 3. Colin Parsons | Colin Parsons |
| 4. John Boryer | John Boryer |
| 5. | Trevor Devon |

**7) Any Other Business:**

Terry Henman suggested that members might like to go on a field trip to the Lake District where he could recommend very good bed and breakfast facilities. He said that he would supply details later on.

John Fowler suggested field trips to Wales as his daughter has six self-contained, self-catering flats for rent in Carnarvon. He said that he would supply details later on.

Diana pointed out that there were three local trips in the 2006 Geologists' Association Field Meetings list that our members could join:
*'The Geology of Beachy Head'*: leader Geoff Toye, on 22nd April 2006
*'The Geology of Some West Sussex Churches'*: leader John Potter on 13th May 2006
'*Wealden Excursion'*: leaders: Pete Austen *et al* on 22nd July 2006

Ken said that he was looking for ways to fund-raise for the Society and hoped that there might be some ideas. He suggested that perhaps we could set up a stall in Alexandra Park during Hastings Week to attract new members.

Ken asked whether anyone was interested in taking on the role of Publicity Officer to report on our meetings for the *'News From the Clubs'* section in *The Hastings Observer*, but no-one volunteered.

Ken reminded everyone of the New Year's Day Walk which would begin with optional lunch at the Smuggler Pub, Pett, at 12 o'clock. The walk would then start at 2 o'clock from the Visitor Centre at Fairlight.

Ken declared the Meeting closed at 3.22 p.m.

# OBITUARIES

Sadly, since our last journal, we have lost two valuable and long standing members of our Society, Stephen Morel and David Dewhirst.

## STEPHEN WILLIAM MOREL

### 10th January, 1925 - 27th June, 2005

Stephen Morel was the twin son of Stephen Hugh Morel and Dorothy Mary Cutbush. He and his brother, Herbert, attended the Whitgift Middle School, Croydon (now Trinity School) until June 1940 when, due to the threat of a German invasion, their parents sent them to relatives in Canada. After graduating from West Hill High School, Montreal, in 1941 at sixteen, Stephen worked for Barclays Bank (Canada) as a junior clerk. On his eighteenth birthday he returned to enlist in the Royal Navy as an ordinary seaman.

He survived a bombing attack on his training camp and then served in the battleship H.M.S. 'Howe'. In 1944 he was commissioned sub-lieutenant and served in tank landing craft until the end of the war. Whilst in Egypt he made several trips to collect fossils from Eocene rocks near to Suez and decided to become a geologist after demobilisation.

Stephen entered University College, London, in 1946 and came under the influence of Sidney Ewart Hollingworth, Yates-Goldschmidt professor of geology, a brilliant field geologist. It was here that Stephen met his future wife, Vivien Mills, a fellow student. She attained a first class honours degree in geology in 1948 and was appointed to the Atomic Energy Division of the British Geological Survey.

They married on New Year's Eve 1949 and set sail for the Nyasaland Protectorate in October 1950. At that time there were no contoured maps of Malawi available and Stephen spent seven years completing compass and traverse wheel surveys of 2000 sq. miles of rugged mountain country in the Shire Highlands and Middle Shire rift valley, where he mapped a transition zone between amphibolite and granulite facies gneisses and also several large plutons of syenite.

In 1955 he published a paper on the phlogopitites of the Shire rift. He also sited some two hundred water boreholes in a village water supply programme utilising resistivity methods devised by the Director of the Geological Survey, Dr. W. G. G. Cooper. Stephen's work in the Middle Shire and Ncheu areas was published by the Nyasaland Geological Survey in 1958 and submitted to London University as his Ph.D. thesis in 1960. Further papers on Malawian rocks were published in 1959, 1960, 1989, & 1990 in the Mineralogical Magazine, Geological Magazine, and Journal of African Earth Sciences.

In August 1957 Stephen transferred to the Cyprus Geological Survey and joined the team of geologists mapping the Troodos ophiolite complex and surrounding sedimentary formations. At that time the EOKA terrorist campaign was at its height and geologists carried firearms for their own protection.

Stephen was seconded to the administration in 1959 as an assistant commissioner in Limassol district for several months during which all geological work was suspended. In 1959 Cyprus became a republic and the British geologists left the Geological Survey.

Accepting an appointment as a lecturer in geology at Sir John Cass College, London, Stephen returned from Cyprus in 1961, and in 1962 he was appointed as senior lecturer in geology at the Northern Polytechnic. With only two full-time staff members and a few part-time staff, he built a successful department from very limited resources. Amongst his students were Dr. Paul Henderson and professors Bernard Wood and Max Coleman. A lack of encouragement for geology from the polytechnic administration led to his resignation in 1968.

He was then appointed principal economic geologist to the Botswana Geological Survey where he investigated the mineral resources of the Tati goldfield. The discovery of nickelcopper mineralization by a private exploration company led to Stephen accepting an appointment as exploration manager for Africa for INCO in 1969. The collapse of the nickel price in 1972 and political considerations regarding South Africa led to INCO closing down the project.

In 1972 he accepted the chair in geology at Fourah Bay College, University of Sierra Leone. This led to a five year stay in which he introduced courses into the geology syllabus suited to a developing tropical country. This included exploration geophysics, exploration geochemistry, engineering geology and hydrogeology at degree level and the department was equipped through the generosity of the Diamond Corporation and INCO.

Stephen suffered a heart attack in late 1976 whilst supervising a geochemical exploration project on a greenstone belt in the northern bush. He then resigned in 1977 following the sacking of the university by a Freetown mob.

He joined Sir William Halcrow and partners in May 1977 to plan a groundwater development programme for Somalia. This was aborted due to war between Somalia and Ethiopia. In 1980 he undertook a mineral survey of western Thailand but he and his wife were both taken seriously ill with dengue fever. Whilst convalescing, Stephen accepted a temporary senior lectureship at Cheltenham and Gloucester College of Higher Education.

In January 1981 he was asked by a Dutch government agency to set up a new geological department in the University of Botswana and was appointed as a professor of geology.

In 1982 Stephen had another heart attack whilst alone in the bush in southern Malawi, but he managed to get to the airport and underwent coronary by-pass surgery in London. He then returned to Botswana to resume teaching until 1985 when he retired to carry out researches at the Free University of Amsterdam.

After retirement, Stephen and his wife settled in East Sussex but also carried out fieldwork in the eastern Algarve and travelled widely in the western U.S.A.

Both Stephen and Vivien were very fond of chamber music and played viola and violin in string quartets with friends. They joined the Hastings and District Geological Society in 1993 and took an active part in the lectures, discussions and occasional field trips.

Stephen is survived by his wife Vivien, four children, the eldest of whom is a geologist, and eleven grandchildren.

## DAVID DEWHIRST

### 1920 - 2006

David was born in Bradford, Yorkshire, in 1920. His only brother, Walter, died about twenty years ago.

As a young man, David studied medicine at university and trained as a doctor at St. Mary's Hospital, London. He was then employed for several years as a hospital registrar.

During the Second World War he served with the Royal Army Medical Corps in India, where he remained as a medical officer until 1947. He returned to London to work in various hospitals until 1956, when he took up General Practice in Liverpool, Manchester and eventually in Rye.

In 1977 David travelled to Saudi Arabia to work as a G.P. for an American company. After eight years he returned to England, bought a house in Winchelsea and continued as a local doctor until his retirement in the late 1980s.

Earlier in his life David met Marion and they were married in 1944. From their marriage there are two daughters (Ann and Deborah), two grandsons (Rupert and Olly) and a great-grand-daughter (Sammy). David and Marion were together for over forty-five years until her death in 1989.

For the past sixteen years his close companion has been Diana, and together they enjoyed many happy holidays.

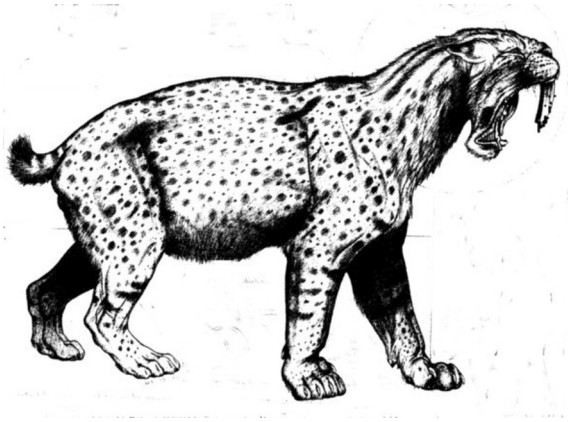
David was a quiet and modest man who always dressed formally and had a great sense of humour. He was fully committed to his family, always loving, caring and supportive to them all. His special interests included gardening, D.I.Y., family history and geology. Since 1994 he had been a member of the Hastings and District Geological Society.

Three weeks after a serious car accident, David died peacefully at the Conquest Hospital on Wednesday 25th October, 2006. He will be sadly missed by all the members, his family and by his many friends.

# THE RANCHO LA BREA TAR PITS

## AND THEIR EXTINCT MAMMALS

**A talk given to the Society by Jim Priestley on the 3rd August 2003**



## Introduction

Thick sticky Petroleum (Asphalt) oozing to the surface at Rancho La Brea during the last 40,000 years formed over 100 deposits of varying size on a 32 hectare (80 acre) site, making traps for thousands of animals, many of which were of species which became extinct about 10,000 to 11,000 years ago, at the end of the last cold period of the Pleistocene Ice Age, when there was the greatest extinction of large animals since the dinosaurs disappeared 64 million years ago.

The George C Page Museum of La Brea Discoveries houses over a million bones and plant remains dug from the "Tar Pits", forming the world's largest and most comprehensive collection of late Pleistocene fossils. Some of the bones have been reassembled into complete skeletons, which are on display at the museum. The museum also has geological exhibitions and paintings by various artists giving their impressions of how the animals might have appeared in life.

## Location

Rancho La Brea is in the Los Angeles Basin, California, at Hancock Park, only about 5 miles from the skyscrapers of downtown Los Angeles and a little less from Hollywood, with the Pacific Ocean 9 miles to the southeast.

## Geology

During the Miocene Epoch the Los Angeles area was in a slowly deepening undersea basin, where thick deposits of marine sediments, containing much organic matter gradually accumulated. The basin was separated from the currents of the open ocean by an underwater ridge, so that the water towards the bottom of the basin was anoxic, therefore the organic matter did not decay and became buried by more sediment.

About 100,000 years ago, regional uplift due to movement between the North American and Pacific Tectonic Plates, combined with dropping sea-levels, brought the basin above the sea, where it was covered by alluvial deposits which were brought down by streams draining south-eastwards from the Santa Monica Mountains across the La Brea flood plain. The fossils are found in pockets of asphalt amongst these deposits.

Then around 10,000 years ago, further tectonic uplift of the Los Angeles Basin diverted the drainage away to the southwest, so that sedimentation ceased and erosion began, exposing the fossil bearing asphalt deposits and thus assisting in the discoveries of fossils.

## The Asphalt

As the organic matter deposited on the bottom of the sea in oxygen-deficient conditions became deeply buried by more sediment, reactions caused by the earth's internal heat transformed some of it into oil. The pressure of the overlying deposits then squeezed this oil into pore spaces in the surrounding rocks,

from where it migrated upwards by way of joints and bedding planes, until it reached various "traps" that were created in the marine sediments by earth movements in the late Pliocene. Some of the oil was trapped in dipping porous strata capped by impervious rock that terminated against the Sixth Street Fault at their upper ends (Fig. 1).

There the oil remained for thousands of years, until about 40,000 years ago more earth movements opened vents from the fault through the overlying flood plain sediments up which oil could slowly escape to the surface, as it has been doing ever since.

As the oil slowly migrates upward, it loses its more volatile fractions by evaporation and is subject to oxidation and bacterial action, so that by the time it oozes to the surface it has become black viscous sticky asphalt. The name "Tar Pits" is misleading, as there are no pools of liquid tar.

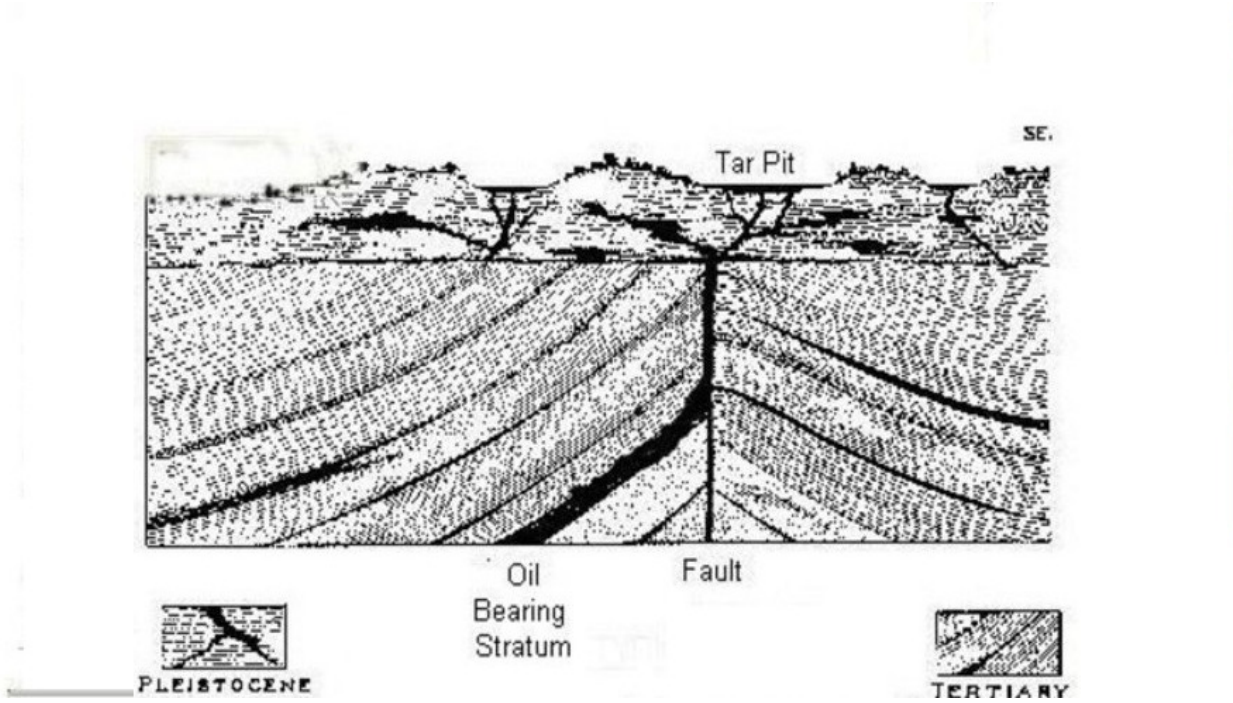



*Fig. 1. Diagrammatic Cross Section showing how oil moves upward to create the Tar Pits*

Radiometric dating has shown that some vents have been constantly active for thousands of years, whilst others produce copious amounts for some weeks and then have a dormant period.

Asphalt is visible oozing out of the ground in several places near the museum, even in the car park and on the lawns. Bubbles of gas can also be seen in some of the water filled excavations, bringing with them small amounts of asphalt to form a dirty grey scum at the edge of the water.

On horizontal surfaces the asphalt forms thin flat layers, but on slopes it flows slowly downward to produce ponds in local depressions. As the surrounding land was built up by alluvium the deposits of asphalt became deeper, so that today they are up to 12 metres (40 feet) deep.

The viscosity of the asphalt varies with temperature. In cold weather it congeals and looses its stickiness and so is unlikely to trap animals. In warmer weather it is more fluid, so it can flow for some distance and easily impregnate porous material over which it flows, whilst water, plant material and windblown dust can hide the surface. Small animals, which are fooled into venturing on to it, easily become mired in the underlying viscous liquid, whilst asphalt impregnated sands form "quick-sands" which are able to entrap large animals. Its adhesive qualities have been likened to well chewed bubble gum and experiments have shown that as little as 75mm (3 inches) could hold the strongest animal. Trapped animals would eventually fall and sink into the asphalt, which preserved their bones.

Asphalt is impervious to water, so that animal bones, shells and plant remains covered by it are unaltered either chemically or physically. Flesh, hair, horns, feathers and similar animal tissues have not been found at La Brea, because bacteria that live in the asphalt consume them. After it has reached the surface the asphalt slowly oxidises to form deposits of a hard rock-like mineral, asphaltite, and it is in these that most of the bones are found.

## Vegetation

The last glaciation lasted from 90,000 to 11,000 years ago; during this time vast ice sheets covered much of the northerly parts of our hemisphere.

The edge of the permanent ice was hundreds of miles north of La Brea, where the climate seems to have been cooler and moister than it is today. Plants that have been found in the asphalt are similar to those that now grow in coastal regions 300 miles further north. The Los Angeles Basin was mainly a savannah, crossed by streams and with clumps of small trees, shrubs and herbs scattered amongst grassy spaces. Fragments of plants found between the teeth of most of the large animals from La Brea indicate that they browsed on the trees and shrubs and that grass had only a minor role in their diet.

As the glaciation was drawing to a close and the ice receded, the basin became hotter and drier and the vegetation changed to the present day sparse scrub of small drought resistant woody bushes.

## Humans At La Brea

The first humans are believed to have entered the Americas around 14,000 years ago by way of a land bridge that existed across what is now the Bering Strait at a time of low sea levels. It is now thought that some might also have come by sea, coasting along the land in canoes.

They gradually spread southwards and some settled on the southern California coast, where they established a robust economy based on fishing. The tribe that settled in the Los Angeles Basin was called the Quaor. It is to be wondered what they might have thought if they had been told that in 2002 a newly discovered planetoid far out in the solar system would be named after them.

A trade in asphalt from La Brea was established along the coast, where it was used for waterproofing canoes and as an adhesive. The most common artefacts discovered at La Brea are elk horn picks for digging solid asphalt and large seashells, which were used for scooping and carrying liquid asphalt. No elk bones have been found at La Brea, so the horns must have been traded from elsewhere. Shells containing La Brea asphalt have been found on the sites of many former settlements up and down the Californian coast.

The only human remains found at La Brea are those of a woman who was around 18 years old when she died about 9,000 years ago. Damage to her skull shows that she died a violent death. Personal and household artefacts found with the body indicate that she had a ceremonial burial.

Spaniards came up from Mexico to establish the first European settlement in Los Angeles in 1781. In 1828, the Mayor of Los Angeles granted two men the rights to exploit the “tar” deposits and establish a cattle ranch, although the citizens of Los Angeles were still permitted to extract asphalt for their own use, mainly roofing. The name they gave to the ranch “La Brea” is Spanish for “The Tar”.

California became part of the United States following the war with Mexico and achieved statehood in 1830.

Henry Hancock took over the ranch in the early 1880’s and began to quarry the asphaltite on a commercial basis and thousands of tons were excavated, using immigrant Chinese labour. Some, which was refined by melting with heat and filtering to remove bones and mineral matter, was shipped to San Francisco for use in preserving timber and filling joints in sett paving. Untreated material was sold to local factories as boiler fuel. The rather misleading name “Tar Pits” comes from these excavations.

Henry Hancock’s son, Allen, having made a fortune from oil wells in and around Rancho La Brea in the early 20th century, gave the 9.3 hectares (23 acres), now known as Hancock Park, to Los Angeles, on condition that a museum would be built there to show fossils found on the site.

The Page Museum Of La Brea Discoveries was opened at Hancock Park in 1977. It was presented to the people of Los Angeles by George C Page, who continued to work on improvements to the museum and its displays until his death in 2000 at the age of 99.

## Palaeontological Studies

The bones encountered in the asphaltite were at first thought to be those of wild cattle and were thrown on one side. Although in 1875 a Professor of geology/palaeontology reported on the unusual bones found in the diggings it was not until 1901 that their scientific collection and identification started and this has continued ever since.

The development of radiocarbon dating in the 1950s showed that the deposits could be divided into distinct time intervals, demonstrating a layering related to time and explaining the asphalt traps in the context of flood plain deposits.

In the 1960's research emphasis turned to the study of plants and smaller animals, including insects, and to an examination of the life history and social behaviour of the more abundant animals.

At the present time evolutionary studies of the various animals are in progress and work is in hand to provide an understanding of the changes in climate, landscape and local environment as the ice receded, aimed, amongst other things, to providing more information as to the factors that led to the extinction of some animals.

## The Fossils

More than 600 different species of animals and plants have been identified in the remains found in the asphalt deposits. Animals include 58 mammals, 138 birds, 24 reptiles, 6 amphibians, 56 molluscs and 168 arthropods.

In plants, 75 diatom species and the pollen, seeds, leaves or wood of 80 larger species have been identified.

Nearly 90% of the fossil mammals found at La Brea were carnivores and nearly 70% of the fossil birds were birds of prey. These proportions are unusual, as in life the number of prey animals would have greatly exceeded the numbers of carnivores and raptors. The explanation seems to be that most of the flesh eaters were pack, pride or flock animals and that several would become mired whilst attacking or eating one prey animal.

## Extinct Herbivores

a) **Horses**. The world's first horses evolved in North America about 55 million years ago, where they became the dominant grazers. They spread via the Bering Strait land bridge to Asia and thence to much of the world. They then became extinct in America and were only re-introduced by Europeans from the 16th century onwards. Some of these escaped to form the large wild horse herds of the North American West.

Two species of extinct horse are represented at La Brea.

The most common is the Western Horse (Fig. 2), the remains of over 220 having been found. It is thought to have had a body similar to a Clydesdale, standing about 14.5 hands (1.46 m/4 ft 10 ins) and weighing some 680 kg (1,500 lbs). Its skeleton closely resembles that of the modern African Zebra.

The smaller Mexican Ass was about the size of a modern donkey and only 3 individuals have been discovered at La Brea. It seems from remains found elsewhere that it preferred a high desert habitat.

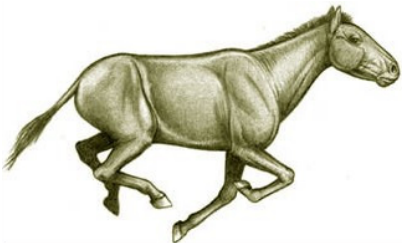


*Fig. 2. Western Horse*

*Fig. 3. Harlan's Ground Sloth*

b) **Giant Ground Sloths**. These were ancient relatives of present day tree sloths, anteaters and armadillos.

In the Late Pleistocene there were four species of giant ground sloth in North America and bones of three species have been found at La Brea.

The largest of these, Harlan's Ground Sloth (Fig. 3) was 6m (20 feet) from nose to tip of tail and weighed up to 4 tons. A reassembled skeleton is one of the largest and most impressive exhibits in the museum.

Unlike other mammals sloths did not have "baby teeth" but kept the set they were born with and these continued to grow throughout their life. Their skeletons had a number of peculiarities, including an extra set of ribs. They had massive cheekbones to form an anchorage for powerful jaw muscles, which enabled them to chew the woody parts of the bushes that formed much of their diet. Their front feet were equipped with huge claws, which probably served for defence as well as assisting in gathering their food. When they stood on their hind legs to pull down branches they stood as high as a modern giraffe.

c) **Mammoths and Mastodons**. The remains of the 35 North American mammoths (Fig. 4) found at La Brea came from only two pits and all seem to have died around 40,000 years ago, indicating that mammoths were in the Los Angeles Basin only briefly, possibly when an unusually rainy period produced large amounts of their main food, grass. It is estimated that they grazed for 20 hours each day and that in that time a large male ate up to ¼ tonne of vegetation.

They were a little larger than African elephants, with adult males standing 3.7 to 4 metres (12 to 13 feet) at the shoulder and weighing 3,600 to 4,540 kg (8,000 to 10,000 lbs).

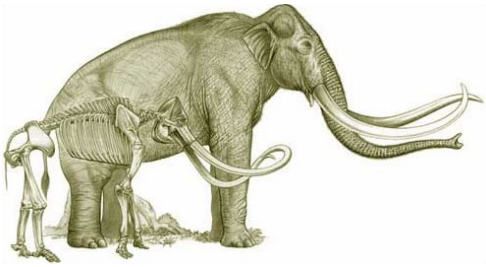


*Fig. 4. North American Mammoth*

The last mastodon species to survive, the American mastodon, was about the size of African elephants and was widespread in North America during the late Pleistocene. Specimens have been found in several of the pits at La Brea.

d) **Camels and Llamas**. Camelids evolved in North America and became extinct there after camels spread to Asia via the Bering Strait land bridge and llamas to South America.

Yesterday's Camel (Fig. 5) lived throughout North America, but the bones of only 36 individuals have been found at La Brea. It was larger than the present day dromedary and stood 2.1 metres (7 feet) at the shoulder. There is some dispute as to whether or not it had a hump. Fragments recovered from between their teeth indicate that they were mainly browsers, eating the leaves of trees and shrubs.

*Fig. 5. Yesterday's Camel*

*Fig. 6. Large Headed Llama*

The other camelid found at La Brea, the Large Headed Llama (Fig. 6), was present in North America in some numbers, but the remains of only 7 have been found at La Brea. It was larger than modern llamas and had proportionally longer legs and neck. They also seem to have been browsers and could probably stand upright on their hind legs to reach the higher leaves.

e) **Bison** (Commonly but erroneously, called "buffalo").

The remains of two species of extinct bison have been found at La Brea.

The Long-Horned Bison resembled the modern species but was the largest North American bison, males being more than 2.8 metres (9 feet) high and weighing almost a tonne, with horns that were 2.2 metres (7 feet) from tip to tip. Its preferred habitat was woodland and only a few have been

found at La Brea.

The other bison, Ancient Bison (Fig. 7), is the most common large herbivore found at La Brea, being represented by more than 300 individuals. It was larger than its direct descendent, the modern bison, with large males over 2.3 metres (7 ft 6 ins) high and weighing as much as ¾ tonne. Immature Ancient Bison are only found at La Brea in the ranges of 2 to 4 months old, 14 to 16 months and 26 to 28 months old. This indicates that the bison were only in the Los Angeles Basin for a short time each year, presumably when rains had produced the grass, which was their main food.

*Fig. 7. Ancient Bison*

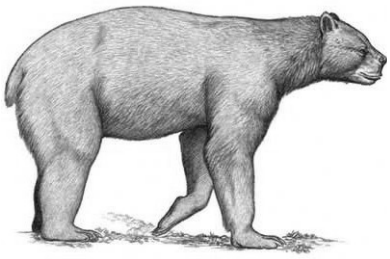


*Fig. 8. Short Faced Bear*

## An Extinct Omnivore

**The Short-Faced Bear**. Remains of over 30 short-faced bears (Fig. 8) have been discovered at La Brea. It was similar to the present day Grizzly Bear but much larger, males weighed up to 818 kg (1,800 lbs) and would have stood 3.6 metres (12 feet) tall when rearing up on their hind legs. The largest modern grizzly bears weigh 635 kg (1,400 lbs) and stand 3.3 metres (11 feet) tall.

Short-Faced Bears only lived in North America, where they were widely distributed in the sort of habitat now favoured by grizzlies.

The short-faced bear's mouth contained the mixed teeth of an omnivorous bear, a single meat-shearing tooth in each jaw and spiked teeth for flesh, with flatter grinding teeth for vegetation. The teeth suggest that, like the grizzly, meat formed much of its diet and, with its long legs and powerful jaws, it was the largest and most powerful predator of its time, quite able to catch large herbivores.

## Extinct Carnivores

a) **The Dire Wolf**. Six species of the dog family have been found at La Brea. These include species that still survive today, the coyote, the grey fox, the timber wolf and two types of domesticated dog.

The only extinct canid, the Dire Wolf (Fig. 9), was the dominant carnivore in the Americas in the late Pleistocene and is by far the most abundant of all the species excavated at La Brea, with over 200,000 specimens. There is a wall display of 404 dire wolf skulls in the Page Museum.

Dire Wolves were similar in size to modern timber wolves but with heavier bodies and stouter, shorter legs. They seem to have hunted co-operatively in packs of about 25 members and their extremely powerful bone crushing jaws would have helped them to kill large animals, such as bison or camels. However, many of the recovered bones show evidence of severe injuries, similar to those that occur to modern timber wolves when tackling large prey.

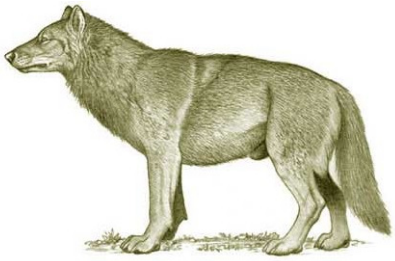


*Fig. 9. Dire Wolf*

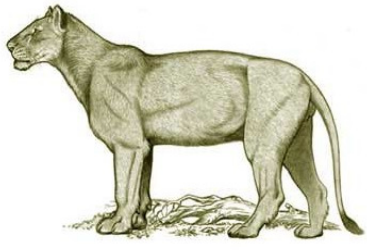


*Fig. 10. American Lion*

b) **The American Lion**. Closely related to the extinct Cave Lion of Europe and Asia and the modern African Lion, the American Lion (Fig. 10) was widely distributed in North America

between 13,000 and 11,000 years ago. Its skeleton was similar to that of the African lion but 20% larger. It is thought that the males did not have a mane. The remains of 80 individuals have been found at La Brea.

c) **The Sabre Toothed Cats**. More than 166,000 bones of this fearsome predator (Fig. 11) have been dug at La Brea. It was about the same size and weight as the modern African lion, although the proportions of its skeleton indicate that it did not chase its prey like a lion but used a stealthy approach followed by a short dash. If caught, large claws on the end of short powerful legs would hold the attacked animal whilst it was bitten to death. Most of this biting would be done by the two extraordinary teeth, up to 20 cm (8 inches) long, in the cat's upper jaw, which would have been capable of penetrating any pachyderm's hide, whilst their razor sharp inner edge could easily rip through flesh. It seems that these teeth had their problems, as several of the heads have severe damage to the upper jaw or skull, presumably as the result of excessive stress when attacking prey.

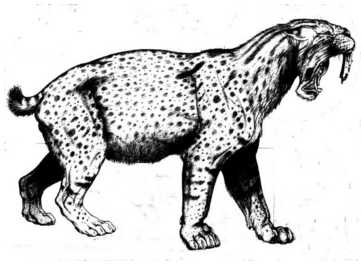


*Fig. 11. Sabre Toothed Cat*

## The Extinctions

Twenty-four (40%) of the mammals whose bones are found at La Brea are now extinct. Scientists disagree about the causes of their extinction and it seems probable that we will never know for sure but the following are the usual suspects.

1. **Climate Change**. All the extinctions occurred around 10,000 to 11,000 years ago, when the Northern Hemisphere was coming out of the last glaciation and warming up so rapidly that the climate zones were moving northwards faster than some of the flora and fauna could adapt. In some areas there was increased rainfall and grassland gave way to dense forests, whilst dryer conditions elsewhere transformed grassland to sparse scrub.

It is significant that, apart from a pronghorn and a species of mouse, the herbivores that became extinct were large browsing animals and had digestive systems that were not particularly efficient in converting the major constituent of vegetation, cellulose, into a form that could be assimilated as nutrients. Such animals require vast amounts of food every day and can only thrive when plenty of vegetation is available, so they were unable to survive in sparse conditions caused by rapid climate change. In the years leading up to the extinctions the size of adults in some species was as much as 25% smaller than those of earlier years, indicating a reduction in available food.

2. **Disease**. With the exception of the American Lion, all the species that became extinct were natives of the Americas. Many related Asiatic species crossed into North America via the land bridge in the years leading up to the extinctions and it is possible that they brought with them diseases to which the native animals had no immunity, so that they would die of ailments which were quite mild for the Asian species.

Just as when Europeans entered the Americas they introduced diseases new to these continents, which wiped out whole tribes of Native Americans, it seems likely that the native animals could have been similarly affected by diseases brought in by Asian animals, particularly if they were already weakened by shortages of food. We have a similar situation today in our own country, where decline of our native Red Squirrel is partly due to disease introduced by the Grey Squirrel, an invader from North America.

3. **Humans**. It seems unlikely that at the time of the extinctions man had the numbers or the technology to destroy all the species that became extinct. For example, it is hard to imagine that men on foot, armed only with stone tipped spears, could have wiped out a species as numerous, wary and swift as the horse. It is possible that they could have contributed by preying on stocks already reduced in numbers by other causes.

Mammoths seem to have been a favourite prey species. It has been established that man was responsible for the end of the world's last population of Siberian Woolly Mammoths, which lived on Wrangel Island, off the Siberian coast until man first entered the island only 4,000 years ago and quickly slaughtered them all. It is therefore possible that man also exterminated the American Mammoth.

Whatever the reason for the extinctions, we must be thankful such fearsome predators as the Dire Wolf, the Short-faced Bear and the Sabre Toothed Cat are no longer with us.

## BARBECUE AT BATTLE BARN FARM – 13th August 2006

**by Barbara Young**

On Sunday 13th August, for the second year running, Trevor and Fiona Devon very kindly hosted the HDGS barbecue at their home at Battle Barn Farm, near Sedlescombe. Twenty-four members (two of whom were new members joining after one of Ken's Rock-a-Nore walks) gathered in the garden at Battle Barn Farm on what fortunately turned into a fine and sunny afternoon following some very stormy weather during the morning!

Trevor and Fiona put on a superb spread of salads and barbecued meats, cooked to perfection, together with some delicious desserts – all of which we were able to enjoy in the sunshine while admiring the trees, the orchids, the well, the fox, the horses and, of course, the view! A couple of our members took advantage of the indoor swimming pool and had a dip in the luxuriously warm water.

Trevor had also set out a magnificent display of minerals from his extensive collection for us to admire and drool over. I'm sure we all learned a lot - even those of us who thought we knew a lot! There was also a beautiful book of mineral drawings to refer to.

All in all, everyone had a very enjoyable afternoon, and our thanks are due to Trevor and Fiona for all their hard work in organising and hosting the event, both this year and last summer.

In fact the barbecue has proved to be so successful and popular we would like to make it an annual event if other members would be willing to provide the venue. I'm sure help could be given with the catering, and perhaps members could bring along some fossil or mineral specimens from their own collections for everyone to see. If you would be prepared to host next year's event, please let Ken Brooks know.

## MINERAL DISPLAY AT THE BARBECUE

In the "Rock Room" Trevor provided several displays of minerals selected from his collection of over 1500 specimens. One of his favourite minerals is pyrites, iron sulphide, also colloquially known as "fools' gold" for its golden lustre. The 30 or so specimens presented showed the wide variety of crystal forms and habits of this ubiquitous mineral, including the very rare acicular form. Also displayed were attractive crystals of other iron sulphides (marcasite and pyrrhotite) and variations that contained copper (chalcopyrite) and arsenic (arsenopyrite).

Keeping to the "iron" theme, Trevor provided a similar wide-ranging display of iron oxides – haematite, magnetite and goethtite: again the crystalline forms of "rust" were extraordinary. Two other famous minerals also had featured displays to show their variety of crystalline forms: calcite and barite.

At his talk the previous month, Trevor had referred to collecting the white silicate minerals (generally zeolites) from basaltic regions such as the Isle of Skye in Scotland and Maharashtra, India: a number of these collected specimens were on display along with some really eye-catching specimens of apophyllite, stilbite, mesolite and heulandite that had been purchased over the years.

A fun display presented a range of different mineral shapes, from cubes to columns and needles to spheres, again illustrating the diversity of mineral forms. Last and also least (in one sense) there was an array of mounted crystal miniatures in a cabinet aesthetically illustrating the mineral kingdom.

It was clear from this exposition that mineral collecting did indeed have many facets: there is the chemical science aspect (Trevor admits to being a chemist); the crystallography (which can hurt the brain a bit!); the aesthetic artistry of many of the specimens; and the sheer joy of actually collecting them, with either hammer and chisel or chequebook!

# BUILDING STONES OF THE ANCIENT WORLD

## H.D.G.S. illustrated talk by Ken Brooks, 15th October 2006

Local stone was an essential element in the development of early civilisations as its availability and quality determined the building styles that they created.

The effective working and use of stone as a building material was a skill acquired by man at an early stage of history in many different regions of the world. Today we can identify their methods of working stone by studying their buildings, quarries and tools which have survived as well as written records.

## EGYPT

For thousands of years the River Nile has carved its way through areas of sandstone, granite and limestone on its 750 mile journey through Egypt to the Mediterranean.

From very early times, and even to the present day, the Egyptians have built their homes with bricks made from mud - an abundant raw material along the banks of the River Nile. It was around five thousand years ago, as organised religion became established, that they began to use locally available stone to construct temples and pyramids (Fig. 1).

*Fig. 1. Pyramid of Chephren, Egypt (Limestone)*

Between 2590 BC and 2500 BC the ancient Egyptians built three huge pyramids on the Giza plateau (near present-day Cairo). The bedrock in this area is a nummulitic limestone dating from the Eocene period (34 - 55 million years ago). It is an interesting thought that some of the largest man-made structures on earth were constructed from the fossil remains of tiny animals.

Work on a pyramid began with the extraction of limestone blocks at a nearby quarry. However, the only tools the Egyptians had were hammers and chisels made from stone (chert/flint or dolorite), but with these primitive tools the Egyptian masons managed to cut and shape great blocks of stone. Even when metals (copper, bronze and later iron) became available for this work, chert was still a popular low-cost alternative. They also used the adze, bow-drill and the saw, with sand (quartz) as a cutting abrasive.

Each block of stone was cut and shaped to fit into the overall design of the pyramid or temple and then transported on rollers or ramps to the construction site.

The pyramids were originally covered with a casing of white limestone which was cut from quarries at Tura and then transported on barges along the Nile to Giza. Unfortunately, in Medieval times most of the casing was removed for buildings in nearby Cairo.

Further south the Aswan area is well-known for its beautiful pink feldspar granite, which was used mainly for statues and obelisks (Fig. 2). Quarry workers hammered stone wedges into slots made with chisels until a block of stone was split from the bedrock.

From Predynastic times much of the shaping of building blocks was done with 'hammer stones' known as pounders and mauls. These were primarily of dolerite (a medium-grained intrusive igneous rock of basaltic composition), although siliceous sandstone, anorthosite gneiss and fine-grained granite were also occasionally used as hammer-stones. With a number of masons working in shifts on different faces, it would probably have taken months, rather than years, to produce a roughly shaped obelisk. Igneous rocks were also employed as grinding stones for smoothing rough,

*Fig. 2. Obelisk at Karnak, Egypt (Pink Granite)*

carved stone surfaces on statues and obelisks. The polishing of these surfaces was probably done with ordinary, quartz-rich sand - of which there is certainly no shortage in Egypt! When ground with water the sand becomes an abrasive paste.

The pharaoh Ramesses II was one of the most prolific builders in ancient Egypt. As a master of propaganda he carried out vast building projects in his quest for immortality. Perhaps the most impressive of all his achievements is the huge temple which was carved from a cliff of red Nubian Sandstone at Abu Simbel in Upper Egypt. With its four monolithic statues of Ramesses, each over 60 feet in height, he elevated himself to the status of a god on earth.

From the late Middle Kingdom onward, sandstone was used for all temples within the sandstone region as well as many of those in the southern part of the limestone region. These included the temples at Denderah, Abydos and Edfu. As no mortar was used, the huge stone blocks were often held in place with 'butterfly' ties made from wood or copper.

## GREECE

Millions of years ago the mountain building processes of tectonic forces converted local limestones into a metamorphic rock. This became the Greeks' favourite building material - marble.

*Fig. 3. The Parthenon, Athens (Marble)*

The Acropolis is a huge outcrop of marble that dominates the centre of Athens. On top of this is the Parthenon (Fig. 3) - a beautiful temple which was built by Pericles between 447 and 438 BC, to celebrate the Greeks' great victory over the Persians at Salamis. In fact, it was the first temple to be constructed entirely of marble (including the roof tiles), with 180,000 tons of Pentelic marble from quarries at nearby Pentelicon. The translucent pure white statues were carved from Parian marble, quarried on Paros, a Cycladic island in the Aegean Sea. Emery (corundum), which was used for polishing and cutting the marble, was mined in Naxos, another Cycladic island.

No mortar or cement was used. Blocks of marble were cut with great precision using metal tools and held in place with iron clamps. These were coated with lead to prevent corrosion (a detail overlooked during early 20th century restoration - which caused more damage when the clamps rusted).

The Parthenon is generally regarded as one of the finest examples of ancient Greek architecture while its sculptures are considered to be the very best that Greek artists produced.

## MEXICO

The rocks found in Central America were also created as a result of geological 'events' which occurred many millions of years ago.

At the end of the Cretaceous period, 65 million years ago, a huge asteroid exploded in the north of what is now the Yucatan peninsula of Mexico. The impact left a vast crater that filled with a shallow sea and sediments which eventually lithified into a creamy-white limestone. Much later, the Maya people built their pyramids and ceremonial centres from this local stone at Chichen Itza (Fig. 4), Uxmal, Palenque and at other sites.

*Fig. 4. Pyramid at Chichen Itza, Mexico (Limestone)*

Natural wells (cenotes) were created when underground streams and rivers carved out caverns in the limestone, which eventually collapsed. In the dry season these wells provided a vital supply of water for Maya settlements. They were also the home of the rain god, Chac, and during long periods of drought, human victims were sacrificed to him in the sacred well at Chichen Itza.

For millions of years much of the Valley of Mexico has been covered by a plateau of lava which poured from active volcanoes. Even today the most famous Mexican volcano, Popocatepetl, is still active.

To the north of Mexico City, between 200 B.C. and A.D. 100, the Toltecs established a huge city on a dusty volcanic plain. Temples and pyramids were built from solidified lava - a porous reddish-brown rock that is surprisingly strong and resistant to erosion. The whole complex was constructed on a rectangular grid plan, with the spectacular 'Pyramid of the Sun' at its centre. As the Toltecs left no written records, the city was later called Teotihuacan ('city of the Gods') by the Aztecs.

## PERU

In Peru the Pacific 'Nazca' plate is being subducted under the South American plate. Over millions of years this tectonic process has created the Andes through volcanic activity and uplift above and along the subduction zone.

*Fig. 5. Sacsayhuaman Temple, Cuzco, Peru (Granite)*

Around AD 1200 the Incas built their capital city, Cuzco, high in the Peruvian Andes. It was here, surrounded by igneous rocks, that they became true masters in the use of stone. They built walls of interlocking blocks without mortar that have successfully withstood earthquakes for centuries. Large stones were shaped and fitted together so precisely that a knife blade cannot be pushed between them (Fig. 5).

The Incas not only regarded stone as a valuable building material, but also as a god which they worshipped for its strength and permanency.

At a quarry the masons hammered wedges into rows of chiselled slots in the rock until it split into a workable slab. This would then be carved into a rectangular shape by pounding with 'hammer stones' made from hard cobbles of igneous rock, such as dolerite.

Some of these stones can weigh between 40 and 60 tonnes. One of the largest monolithic blocks ever worked by the Incas is 12 feet high, 7 feet across and weighs over 100 tonnes. It may be seen at Sacsayhuaman, an impressive temple/fortress overlooking Cuzco.

How were the Incas able to transport huge blocks of stone without the use of draught animals or the wheel? In the absence of any written records, there have been many theories. However, the remains of cobbled roads leading to temple sites may provide an important clue. Experiments have shown that large blocks of stone could be pulled along on the cobbles by a fairly small group of workers. Even rivers might not be a problem, as stones could be dragged across on natural cobbles in shallow parts of the river bed.

Tectonic uplift has formed mountains of what were once deeply buried igneous rocks. It was here in the Andes that the Incas built their granite city in the clouds, perhaps as a ceremonial centre for religious rituals. This was Machu Picchu, the famous 'lost city' which was discovered by Hiram Bingham in 1911.

The stone working techniques employed by ancient masons illustrate their awareness of the properties of stone and geological features such as jointing and bedding. For these reasons I believe that we should recognise them as among the first true geologists!

# Smokejacks Brickworks

## by Peter Austen

Smokejacks Brickworks (Grid reference TQ 116372) is situated just south of Walliswood, 4 km southwest of the village of Ockley in Surrey. It is one of the largest working brickpits in the Weald, and in 2000 a new computerised clay-to-brick processing plant was completed. In 2004 the site was taken over by Wienerberger Limited, one of the largest brick producers in Europe.

Smokejacks lies near the base of the Upper Weald Clay and is Lower Barremian in age. BGS Bed 5c (Alfold Sand) has been identified near the top of the exposed sequence in the southern corner of the pit. At the time of deposition (around 120-125 million years ago) southern England lay in mid latitudes and the climate was very warm (warm-temperate to sub-tropical). Most of southeast England formed what we call the Weald Basin, and the Weald Clay is considered to represent a low-lying wetland with open water (Austen, Agar & Jarzembowski, 2003). At Smokejacks a 23m section is exposed, the bottom 13m of which is thought to represent a shallow lake or lagoon with fluctuating salinity, and the top 10m mudflats and sluggish river channels (Ross & Cook, 1995). The stratigraphy and palaeontology of the site were described by Ross & Cook (1995), and although some of the sections have changed since publication, it is still possible to use their lithostratigraphical logs to identify the stratigraphical position of most *in situ* finds.

This Weald Clay brickpit has yielded a number of important finds over recent years. In 1983 Bill Walker, a local collector, found a new theropod dinosaur, *Baryonyx walkeri*, a find which proved to be the key to the understanding and reinterpretation of the spinosaurs. On the Geologists' Association fieldtrip to the site in 2001, a well-preserved partial skeleton of a juvenile *Iguanodon* was discovered in the same bed as *Baryonyx*. During the excavation of the skeleton by the Natural History Museum, two *Baryonyx* teeth were also recovered, suggesting that the *Iguanodon* carcass may have been scavenged by *Baryonyx*. A *Titanosaurus*-like sauropod is also known from the pit (Jarzembowski, 1991).

The site is also known for the early 'flowering plant' *Bevhalstia pebja*, which was first described in 1996 (Hill, 1996). Since then more remains of the plant have been found, some showing cellular structure and others showing seed-like structures in association with the plant.

The concretions of sideritic ironstone and fine grained calcareous sandstone have also yielded numerous insect remains (at least 13 orders) including Blattodea (cockroaches), Coleoptera (beetles), Diptera (true flies), Hemiptera (true bugs), Hymenoptera (wasps, bees and ants), Isoptera (termites), Mecoptera (scorpion flies), Neuroptera (lacewings and snake flies), Odonata (dragonflies) and Orthoptera (crickets and grasshoppers). Recent finds have included new species of leafhopper and scorpionfly.

Remains of dinosaur, fish, shark, crocodile, molluscs, non-angiospermous plants and trace fossils can also be found. Recent discoveries have included an arthropod trackway, the first to be found in the Wealden, a small cone similar to the present day *Sequoia* (Austen, 2005), and in 2005 a spectacular death-bed assemblage of teleost fish, which included the first articulated pycnodont fish to be found in the Wealden.

Details of fieldtrips to Smokejacks Brickworks in 2007 can be found on page 32.

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# *IGUANODON* FOOT-CAST FOUND AT FAIRLIGHT

**by Ken Brooks**

On 26th September 2006 the BBC television programme 'South East Today' featured a report about a dinosaur foot-cast which had been discovered 'somewhere along the beach near Hastings'.

The following day two members of the Hastings & District Geological Society, Dale Smith and Ken Brooks, decided to investigate – but first they had to locate the cast on a five mile (7.5 km) stretch of coast ! It was decided to walk westwards from Cliff End along the beach towards Fairlight. After about two miles (3 km), and by using local knowledge of the cliffs, the foot-cast was eventually found on a large block of siltstone at Lee Ness (Fig. 1). At this location a siltstone ledge about five feet (1.5 metres) thick dips down to beach level. The cast measured eighteen inches (45 cm) from heel to toe and was identified as belonging to the dinosaur, *Iguanodon*.

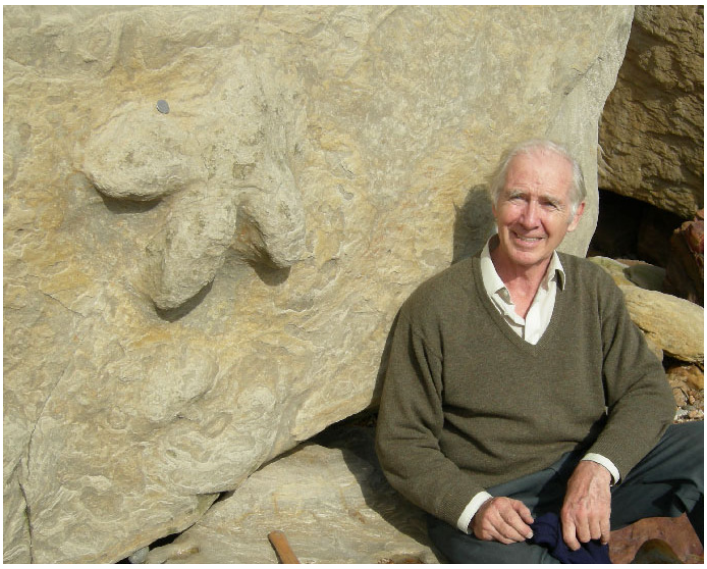


*Fig. 1. Iguanodon foot-cast (10 p coin (and Ken Brooks) for scale)* *Photo: Peter Marsden*

A few days later Colin Parsons, Peter Marsden and Ken Brooks returned to the site to make a mould of the foot-cast. This involved carrying a variety of materials to the site, including containers of fresh water, five kilos of plaster of Paris, a roll of hessian, a gas blow-lamp, a mixing bowl, a tin of liquid latex rubber, brushes and scissors.

After using the blow-lamp to remove moisture from the surface of the cast, it was coated with latex rubber. This was followed by layers of hessian and plaster of Paris. While waiting for this to set hard, further investigation of fallen blocks of siltstone revealed a number of less well-preserved *Iguanodon* foot-casts as well as two rarer theropod foot-casts (Fig. 2). The plaster mould of the *Iguanodon* foot-cast was then removed successfully. It will now be used to produce fibreglass reproductions for display and as a teaching aid.

The siltstone ledge within the Lower Ashdown Formation ('Fairlight Clay') is known for its well-preserved dinosaur foot-casts. These were formed during the Lower Cretaceous (138 million years ago) when grazing dinosaurs left their footprints in soft mud or clay. The foot impressions then filled with a silty sediment, which later became lithified into a siltstone. Much later, when sea erosion of the cliff removed the soft underlying clay, it revealed the footprints as casts at the base of the siltstone.

*Fig. 2. Theropod foot-cast (10 p coin for scale)* *Photo: Peter Marsden*

Photographs selected by editors.

# PALAEONTOLOGY IN THE NEWS

## A REVIEW OF RECENT RESEARCH AND DISCOVERIES

**Edited by Peter Austen**

### New Pterosaurs from China

Two new fossil pterosaurs have been discovered in the now famous Liaoning deposits of northeastern China (*Nature*, 2005, Vol. 437, p.875-879). These deposits, known as the Jehol Group and comprising the Yixian and Jiufotang Formations, span about 5 million years of the Lower Cretaceous from around 120 to 125 million years ago. The two new pterosaurs, *Feilongus youngi* and *Nurhachius ignaciobritoi*, belong to a group previously found only in Europe and bring the number of species of pterosaurs in these deposits to 13 with three still to be described. The Jehol Group also contains 21 species of bird with five still to be described. A preliminary analysis by the authors of the finds to date show that the birds are more diverse than the pterosaurs (2,000 birds to 140 pterosaurs), and that the birds were confined to more terrestrial, inland regions, whereas pterosaurs dominated the coastal areas.

### Pterosaur flight

Pterosaur flight has always posed a problem. Calculations based on the known fossils failed to explain how pterosaurs could generate enough lift to become airborne from a standing start, or how they could fly slowly enough to land without breaking their bones, despite fossilised pterosaur tracks saying that they could do both. However, these calculations did not take into account a unique extra wrist bone called a pteroid. Researchers at the University of Cambridge (*Proceedings of the Royal Society B: Biological Sciences*, 2006, Vol. 273, No. 1582, p.119-126) have used scale models of pterosaur wings, using the pteroid to support a membranous forewing (essentially a wing flap) to generate extra lift for take off, and reduce speed for landing. They found that it boosted lift by around 30%, and could also be used to reduce speed by around 15%. So pterosaurs could fly!

### Velociraptor

Velociraptor is often portrayed as using its claws to slash and dismember its prey (Jurassic Park). New research by Phil Manning at the University of Manchester (*Biology Letters*, 2006, Vol. 2, No. 1, p.110-112) has used a scale model of a hydraulic robotic claw to show that it did not have enough power to do this. He now thinks that Velociraptor gripped its prey with its claws (similar to a lion gripping a buffalo) and then used its razor sharp teeth to bite into its prey, so that it bled to death.

### Ice Caps in the Cretaceous?

The Cretaceous period is generally considered to have been a period of warm climate, and is often taken as an example of the Earth's climate in greenhouse mode. However, there is evidence for cooler periods within the Cretaceous, although up to now the main source of information, the oxygen isotope composition of planktonic foraminifera, has been useful only for a broad interpretation. Now researchers in Germany, France and the Netherlands (*Nature*, 2005, Vol. 437, p.1341-1344) have used the oxygen isotope composition of the shells of large-sized rudist bivalves that lived in warm, shallow seas, to gain a much clearer picture. The researchers found that during warm Cretaceous episodes, seasonal variations (summer/winter) were low, but during cooler periods the variation between summer and winter was similar to that which is experienced today, and is compatible with the presence of polar ice sheets.

### Why could dinosaurs grow so big?

Researchers at the University of Bonn have put forward a possible reason why dinosaurs were able to grow to such a large size (*New Scientist*, 2005, Vol. 188, No. 2523, p.14). Some of the largest plant eating sauropods could grow to 40 metres in length and weigh in at around 100 tonnes. They have suggested that they were able to grow to such a large size because they had bird-like lungs. Birds have nine extra air sacs to supplement their lungs and the researchers believe that the large sauropods could have had a similar anatomy, with the hollow regions of the neck and upper back vertebrae containing air sacs. Whereas the birds use their efficient lungs to drive a high metabolic rate and aid flying, the sauropods used their large lung capacity to increase their size.

## *Tyrannosaurus rex* sense of smell

Researchers at the Royal Tyrrell Museum of Palaeontology in Canada (*New Scientist*, 2005, Vol. 188, No. 2523, p.15) have analysed the relative sizes of the olfactory lobes (the part of the brain used for smell) of birds, crocodiles and the two-legged predatory dinosaurs (theropods). They found that of all the theropods *T.rex* had the largest olfactory lobe, and would have had a much keener sense of smell than the other giant predatory dinosaurs. *T.rex* would have been able to sniff out prey (and carrion) at some considerable distance.

## Cretaceous grass

Up to now it has been thought that grasses first appeared around 55 million years ago, which is 10 million years after the demise of the dinosaurs. However, researchers at the Swedish Museum of Natural History in Stockholm, Sweden (*Science*, 2005, Vol. 310, p.1177-1180), have discovered silica structures, called phytoliths, in 65 to 70 million year old dinosaur dung from Central India. It is thought to be from a titanosaur sauropod whose remains were found nearby. Phytoliths grow inside plant cells and can survive digestion and fossilisation, and analysis of these phytoliths revealed that some of them had the distinctive shapes only seen in grasses. The only previous evidence from rocks of this age was fossilised pollen, but as all grass pollen looks the same it had been dismissed as either a very primitive grass or an early relative. However, the Indian phytoliths are much more distinctive and have been linked to five less-primitive species of grass, implying that the grasses had started to diversify before the disappearance of the dinosaurs.

## Eurypterids could walk on land

Eurypterids, which are known as water scorpions, are the largest arthropods that have ever lived, and could grow up to 2 metres in length. Martin Whyte from the University of Sheffield has found a fossilised track left by a 1.6 metre eurypterid in 330 million year old Carboniferous rocks in Scotland (*New Scientist*, 2005, Vol. 188, No. 2528, p.20). The trackway, which is 6 metres long, is seen to confirm that the arthropod could walk on land, the subject of a long-running debate.

## 'Lost' *Archaeopteryx* back on display

The world's best preserved *Archaeopteryx* is to go on display in the Wyoming Dinosaur Center, USA, after many years in a private collection (*Science*, 2005, Vol. 310, No. 5753, p.1483-1486). The specimen came to light in 2000 after the widow of the first owner decided to sell it. It was bought by a private collector who agreed that it should be kept on permanent display in the Wyoming Dinosaur Center. The *Archaeopteryx*, which is one of only nine known specimens, comes from the limestone quarries at Solnhofen in Bavaria, Germany, as do all the other specimens. However, its exceptional preservation reveals that it was even more dinosaur-like than was originally thought, showing features not previously recognised that link it to both the 'raptor' dinosaurs and to modern birds.

## Fish locomotion

Before the first four legged animals could move onto land, their fish ancestors had to acquire a number of adaptations, including legs and supporting shoulder and pelvic girdles. Scientists in Sweden (*Nature*, 2005, Vol. 438, p.1145-1147) have studied a specimen of *Panderichthys*, originally found in Latvia in 1972, which has thrown new light on these changes. *Panderichthys* is the closest fish relative to the first tetrapod, and the specimen's well-preserved pelvic fin and supporting pelvis show that *Panderichthys* could have moved onto land by anchoring its pelvic fins on the ground and dragging itself along in a similar way to that of the modern walking catfish.

## Chinese fossil mammal

An almost complete specimen of an early mammal has been found in the Lower Cretaceous Liaoning deposits of northeastern China (*Nature*, 2006, Vol. 439, p.195-200). The new mammal, *Akidolestes cifellii*, was found in the Yixian Formation and has been dated at around 124.6 million years old. The mammal is that of a 'spalacotheroid symmetrodont' a relative of modern therians (the marsupials and placentals) and is very similar (although unrelated) to the platypus. It is thought that the spalacotheroids evolved initially in Eurasia and then dispersed to colonise North America.

Editors Note: The first spalacotheroid symmetrodont mammal to be described was a single tooth (upper molar) found at Cliff End, near Hastings (approx. 135 million years old). It was described by Richard Owen in 1854.

## Ornamented Dinosaurs

The discovery of a rich deposit of fossils from the Upper Jurassic (about 155 million years ago) of northwestern China, has yielded the earliest known member of the group that eventually led to the tyrannosaurs. The skeletons of two individuals, named *Guanlong wucaii*, were discovered, one adult and one juvenile (*Nature*, 2006, Vol. 439, p.715-718). They were small carnivorous dinosaurs about 3 metres long, and had an elaborate head-crest, something not seen in other dinosaurs. The scientists describing the fossils believe that it could be an exaggerated ornament used to impress a potential mate, in the same vein as the antlers of the Irish Elk or the long tail of a male peacock.

## Early atmosphere

Scientists at the University of California claim that the rise in oxygen in the Earth's atmosphere that led to the explosion of life at the start of the Cambrian period, 550 million years ago, was all down to clay (*Science*, 2006, Vol. 311, p.1446-1449). The Earth has contained free oxygen since photosynthesis evolved 2.8 billion years ago, however it did not rise above 0.2% until the start of the Cambrian, thus allowing multi-cellular life to evolve. The team claim that organic carbon (debris from dead organisms), which would have reacted with and kept oxygen levels low, became trapped in clays allowing the oxygen levels to rise. They based their findings on a study of the clay content of shale deposits from 850 to 530 million years ago, and found that the percentage of clay in them increased over that period to near modern levels. This could have been caused by microbes and fungi moving onto land, increasing the weathering of rocks and producing more clay.

## Early life

Japanese researchers have found evidence of methane-producing microbes dating back 3.5 billion years (700 million years earlier than thought) (*Nature*, 2006, Vol. 440, p.516-519). They extracted gas bubbles from liquid inclusions in ancient rocks from the Pilbara Craton in Western Australia, and analysis of the gas confirmed that it was produced by methane-producing microbes (methanogens). It is thought that methanogens were important in regulating the Earth's early climate, producing sufficient greenhouse gas to keep the surface temperature of Earth above freezing at a time when the sun was much less bright than today.

## When fish moved onto land

Following five years of field work in the Canadian Arctic, a team of US palaeontologists have discovered an exceptionally well-preserved group of fossils representing an almost perfect intermediate stage between the fishes and the tetrapods (*Nature*, 2006, Vol. 440, p.757-763, 764-771). It has long been clear that the limbed vertebrates (tetrapods) had evolved from lobe-finned fishes, but apart from isolated hints at the transitional forms, the two groups were separated by a period of 20 million years. At the bottom we had *Panderichthys*, a tetrapod-like predatory fish, from the 385 million year old Middle Devonian of Latvia, and at the top was *Ichthyostega* and *Acanthostega*, primitive tetrapods from the 365 million year old Devonian of Greenland, with fragmentary tetrapods from Scotland and Latvia dating to 376 million years ago in between. The team identified the type of rock where they thought they might find the transitional forms, and spent five field seasons searching for them. The exceptional preservation of the fossils, named as *Tiktaalik roseae*, showed previously unknown detail of the neck, gill and fins.

## Snake evolution

The discovery of a fossil snake, *Najash rionegrina*, in the Cretaceous of Argentina has thrown new light on their development (*Nature*, 2006, Vol. 440, p.1037-1040). It had previously been thought that the snakes had a marine origin, but features of the newly discovered snake, particularly its sacrum, supporting pelvic girdle and robust legs, now lead researchers to believe that snakes had a terrestrial, burrowing origin.

## Archaean Stromatolites are life

Since the 1960's there has been some debate as to whether or not fossil stromatolites from the Archaean Period had a biological or non-biological origin. A new study of stromatolites from the Strelley Pool Chert Formation in the Pilbara Craton in Western Australia has convinced a team of researchers that they have a biological origin (*Nature*, 2006, Vol. 441, p.714-718). They mapped the 3.43 billion year old stromatolites over an area that was more than 10k long, and concluded that not only were they biological in origin, but that they also formed an entire ecosystem.

## Dwarf sauropod dinosaurs

It has always been thought that the sauropod dinosaurs were all very large, but a new analysis of sauropod remains from Germany, has shown that dwarf species did exist (*Nature*, 2006, Vol. 441, p.739-741). The proof came when researchers analysed small sections of the sauropod bones (previously thought to be juveniles) and found them to be fully grown adults. They believe that the Late Jurassic dinosaurs were isolated on the large islands in the Lower Saxony Basin. They have been named *Europasaurus holgeri*.

## Fossil lampreys

The early Cretaceous Jehol biota from northeastern China continues to produce new and unusual material. Lampreys, a jawless vertebrate group, are common today in freshwater and coastal areas of cold and temperate zones, but their fossil record is very sparse. Only two fossil lamprey species are known, both from the 300 million year old Carboniferous of North America. Now, however, a fossil lamprey, *Mesomyzon mengae*, has been found in the 125 million year old early Cretaceous Jehol Group (*Nature*, 2006, Vol. 441, p.972-974). The fossil shows that by 100 million years ago the lamprey had assumed its modern form.

## More dinosaurs still to be found

A statistician and palaeontologist from Pennsylvania, USA, have used a mathematical model to estimate the number of dinosaur genera still to be found (*Proceedings of the National Academy of Sciences*, 2006, Vol. 103, p.13601-13605). Currently we know of 527 different genera of dinosaur and they estimate that there are over 1,300 still to be discovered. This is perhaps mirrored by the large number of new dinosaurs being discovered each year in China and South America. Half of all known dinosaurs have been discovered in the last 20 years, and they are still coming. An area of the world that has potential for future dinosaur discoveries is Africa, where large areas remain to be explored for fossils. Keep on looking!

## Record dinosaur find

A team led by Jack Horner of Montana State University, USA, has unearthed a record 67 dinosaurs in one week from Mongolia's Gobi Desert (*New Scientist*, 2006, Vol. 191, No. 2570, p.5). The fossils were mainly those of a psittacosaurus, a common beaked plant-eater, known as the "parrot lizard" that lived around 120 million years ago.

# Extracts from '*Wealden News*'

**by Peter Austen**

## Introduction

*Wealden News* is a newsletter produced annually by myself and Ed Jarzembowski, which covers items of interest relating to the Wealden deposits of southern England that may not necessarily be covered in the scientific or national press. These can be new fossil finds, reports on stratigraphy or new publications. Below are extracts from the May 2005 issue of *Wealden News* (No. 6) that have a local interest to the Hastings & District Geological Society. Any website references have been updated.

The full version can be accessed by going to www.kentrigs.org.uk/newflash.html and clicking on "Wealden News No6". The file is in pdf format, and is 7.8 Mbytes, and if you do not have broadband it will take about 35 minutes to download.

## Bexhill's largest dinosaur

In 2004, Frank Hamill found the finger bone (Fig. 1) of a large sauropod dinosaur on Bexhill beach. The bone has been identified by Angela Milner at the Natural History Museum as a diplodocid metacarpal, either from the third or fourth finger of the left hand (Fig. 2 for reconstruction). Until now, remains of large plant-eating sauropods from the Wealden have not been found on mainland Britain, although remains have been found from the Wessex Wealden on the Isle of Wight. The size of the finger bone makes this beast larger than the *Diplodocus* skeleton on display in the Entrance Gallery of the Natural History Museum. Several years ago, Frank found the partial skull of an *Iguanodon* also at Bexhill. Frank has kindly donated the finger bone to the Bexhill Museum, as he did with his previous find, where it will be displayed in the new dinosaur display.

**Reference**

NORMAN, D.B. 1999. *The Illustrated Encyclopedia of Dinosaurs*. Salamander Books, London, 208pp.

*Fig. 1. Finger bone (metacarpal) of a large diplodocid dinosaur (scale bar = 10 cm.)* *Photo: Peter Austen*

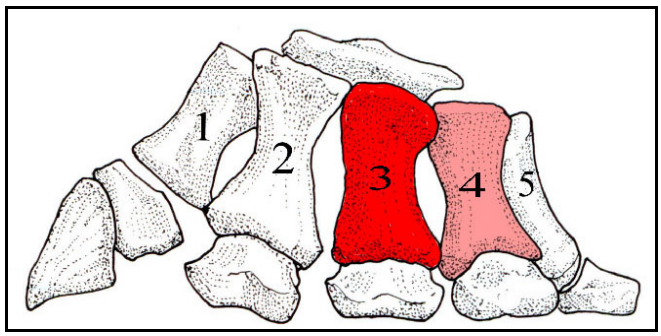



*Fig. 2. Reconstruction of diplodocid hand. Third and fourth metacarpals highlighted (adapted from Norman, 1999).*

## Cooden shark head in Japanese museum

Paul Davis (Natural History Museum) reports a well preserved skull of the shark *Egertonodus basanus* in Ibaraki Museum in Japan. The shark is thought to be from Cooden, East Sussex. Paul writes:

'The skull is 9 cm long. You have a frontal view (Fig. 3), a right lateral view (Fig. 4) and a dorsal view

*Fig. 3. Frontal view of* Egertonodus basanus. *Photo: Paul Davis*

*Fig. 4. Right lateral view of* Egertonodus basanus. *Photo: Paul Davis*

*Fig. 5. Dorsal view of* Egertonodus basanus. *Photo: Paul Davis*

showing the whole nodule (Fig. 5). The bones in the nodule behind the skull are the cleithra - which are parts of the pectoral girdle.'

We welcome your reports and photographs of other Wealden fossils in other distant museums.

## Dinosaur braincase from Hastings

Alan Prowse reports the discovery of a dinosaur braincase (endocranium) (Figs 6 & 7) from Hastings. Although the specimen is water worn and partially eroded, it clearly shows the node-shaped protrusion (basioccipital) which attaches the skull to the vertebral column. It is possible that the endocranium belongs to a nodosaurid ankylosaur. These are a family of armoured dinosaur that contain *Polacanthus* and *Hylaeosaurus*, both of which have been found in the south of England, although some authors believe that they are one and the same animal.

*Fig. 6. Nodosaur? endocranium (scale in cm.)* *Photo: Jerry Kennington*

*Fig. 7. Nodosaur? endocranium* *Photo: Jerry Kennington*

## Cliff End *Iguanodon* find

Early in 2002 following heavy storms in the southeast, Luke Booth found the remains of an *Iguanodon* in a large cliff fall at Cliff End, near Hastings (Fig. 8). Luke recovered a number of vertebrae and ribs, which he has donated to Maidstone Museum. Following extensive preparation by David Rayner some are now on display in Maidstone Museum's newly refurbished Earth Heritage Gallery. The discovery was also the subject of a Channel 4 programme in their recent series 'Big Monster Dig'. Programme details can be found on www.channel4.com (enter 'Big Monster Dig' into the sites search facility, click on the first item - this will take you to the 'Big Monster Dig' home page, click on 'Programmes', click on 'Programme 1 Hastings *Iguanodon*') [site last accessed 22nd November 2006].

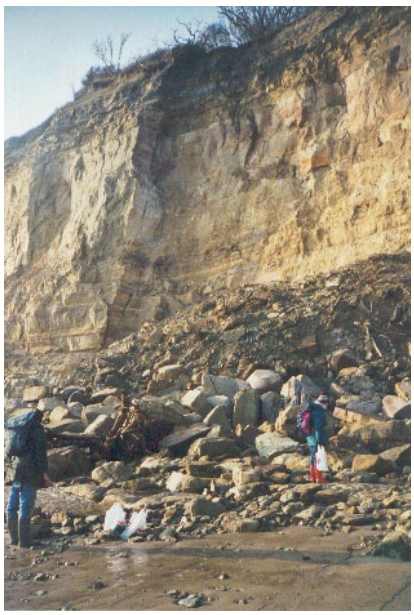


*Fig. 8. Site of Cliff End* Iguanodon *find - Luke at left.* *Photo: Peter Austen*

## Quillwort stratigraphy revised at Cliff End

Thanks to Richard Baldwin for a recent visit to Cliff End to resolve the exact stratigraphy of the quillwort beds (see No. 5 of *Wealden News* 'Recent fossil plant finds from the Hastings area'). The quillworts occur in a protruding ledge of consolidated but weakly cemented fine sand (Fig. 9) which first becomes apparent under the cliff face about 240 metres southwest of the point where the concrete walkway ends. We have previously taken this outcrop to mark the top of the Ashdown Beds. However, our recent visit with Richard allowed us to plot the exact stratigraphy and establish beyond doubt that the quillworts occur about 6 m below the top of the Ashdown Beds. In Lake & Shephard-Thorn (1987) it is the lowermost bed

recorded in their stratigraphical column covering the section from Haddock's Reversed Fault to Cliff End (page 67 - Sandstone, fine grained, silty, yellow, with hard ferruginous crust, up to 25 mm at top - seen to 1.25 m).

Also John Evans has recently reported finding remains of the quillwort at Rock-a-Nore. Previously, on the coastal section, it has only been recorded at Cliff End.

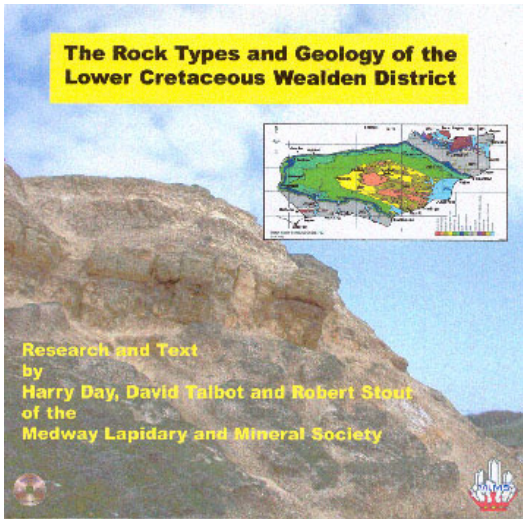
**Reference**

LAKE, R.D. & SHEPHARD-THORN, E.R. 1987. Geology of the country around Hastings and Dungeness. *Memoir of the British Geological Survey*, Sheets 320 & 321, England and Wales.

Peter & Joyce Austen

*Fig. 9. Site of Cliff End quillwort bed - quillworts marked.*
*Photo: Paul Davis*

## Prestigious award to Wealden CD team




In our issue No. 3, November 1999, we reported on the efforts of a team from the Medway Lapidary and Mineral Society to collect and document a selection of Wealden rocks representative of the Wealden beds of southeast England. The intention was that these would be deposited at Maidstone Museum to be used as a reference collection. The Society received two awards from the Heritage Lottery Fund 'Awards for All', which helped fund the purchase of the equipment and software needed for the project. The project was completed at the start of 2004 and resulted in the issue of a CD-Rom 'The Rock Types and Geology of the Lower Cretaceous Wealden District' with samples and thin sections of all the rocks on the CD-Rom being deposited in Maidstone Museum. The project has now been awarded the prestigious **ENI Geological Challenge Award for 2004**. This award is made annually in recognition of those whose work makes a major contribution to the understanding of the geology and landscape of Britain. This year saw a record number of entries of the highest quality, so congratulations to the Medway team, **Harry Day, David Talbot and Robert Stout** on their excellent achievement.

Copies of the CD-Rom are available from Harry Day on 01634 725044, for £12.00 + £1.50 UK postage. All profits made from the sale of the CD-Rom go to the Medway Lapidary and Mineral Society.

## Warnham otolith

Geoff Toye reports the discovery of an otolith (fish ear bone) from Warnham Brickworks in Surrey (Fig. 10). Although otoliths have been recorded from the preceding Jurassic period, this is the first record of an otolith from the Wealden. Warnham Brickworks has exposures of BGS Bed 2a (Lower Weald Clay, Hauterivian) in the Wealden succession. There must be many more otoliths waiting to be found.

*Fig. 10. Otolith (fish ear bone) from Warnham (length 1.5 mm).*
*Photo: Peter Austen*

## Update on '*Wealden News*'

### Dinosaur Braincase from Hastings

Since the publication of this article the Natural History Museum has confirmed that the braincase found by Alan Prowse at Hastings is that of an ankylosaur, possibly *Hylaeosaurus*, and he has kindly agreed to donate it to the Natural History Museum. This is an extremely important specimen as there are no known specimens of the skull or braincase of Wealden ankylosaurs.

### Warnham otoliths

Since the publication of the first recorded Wealden otolith at Warnham, many more have been found, both at Warnham and at Clockhouse. Warnham and Clockhouse are both in the Lower Weald Clay, and although they are not local to Hastings, I have included this article because there is no reason why they shouldn't also be found in the deposits at Hastings. It is unlikely they will be present there in the same abundance as in the Weald Clay because the lithology of the two deposits is quite different, nevertheless it would be worth keeping an eye open for them.

# GEOLOGICAL WEBSITES

## USEFUL WEBSITES WITH A GEOLOGICAL INTEREST

**Edited by Peter Austen**

The internet is home to tens of thousands of websites with a geological interest, and it is often difficult to sort the wheat from the chaff. For every quality website there are many which leave a lot to be desired. As a general rule university and museum websites are fairly good, but I've tried to list below (in no particular order) sites which are worth a visit, together with a brief description of their content. If you have not got a computer at home, all libraries in the UK are now equipped with computers with internet access for use by the general public.

All sites were valid as at 29th November 2006.

If you know of any particularly good websites then please let me know and I will include them in the next issue of our Society Journal.

### Royal Society Journals – free online access for a limited period (from 1665)

**http://www.journals.royalsoc.ac.uk**

You need to be quick on this one! The Royal Society is offering free online access to all of its journals until the **31st December 2006**. The journals date back to 1665, and with more than 60,000 articles forms one of the largest science archives in the world. However, unless you know the exact paper you want, it may be advisable to use key words in the site's search engine.

### Links for Palaeobotanists

**http://www.uni-wuerzburg.de/mineralogie/palbot1.html**

This site refers to itself as "An annotated collection of pointers to information on palaeobotany or to WWW resources which may be of use to palaeobotanists (with an Upper Triassic bias)". In reality, although it does have a palaeobotanical bias, it contains a wealth of information on all aspects of geology and palaeontology, and is updated daily.

### Fossils of the Gault Clay and Folkestone Beds of Kent, UK

**http://www.gaultammonite.co.uk**

This is a quite exceptional site describing in detail the Cretaceous fossils of the Gault Clay and Folkestone Beds of Kent, and is a must if you are interested in Gault Clay fossils, or wish to visit Folkestone. The site was produced by the late Jim Craig, and is now maintained by Fred Clouter (see below). The site was shortlisted for the Pirelli Science Prize when first produced in 2001 and in 2004 won the Golden Trilobite Award from the Palaeontolgical Association for the best amateur site.

**Lower Eocene fossils of the London Clay from the Isle of Sheppey**
**http://www.sheppeyfossils.com/home.htm**
This is an excellent site if you are interested in fossils from the London Clay of the Isle of Sheppey (Lower Eocene). The site is produced by Fred Clouter (who also manages the Folkestone Gault Clay site), and contains high quality photos of the fossils that can be found there.

**Discovering Fossils**
**http://www.discoveringfossils.co.uk**
Launched in 2002, Discovering Fossils is produced by Roy Shepherd and is an excellent resource for organising field trips. It contains information on sites throughout the UK, including details of the site and what can be found there. There are also organised field trips to most of the sites listed.

**UKGE Ltd – Geological Equipment Suppliers**
**http://www.ukge.co.uk**
A useful site if you wish to purchase any books or geological equipment.

**Set in Stone – produced by the Natural History Museum**
**http://www.nhm.ac.uk/research-curation/departments/palaeontology/news-events/newsletter-sis/set-in-stone.html**
The Natural History Museum's Palaeontology Department publishes a quarterly online newsletter *Set in Stone*. The newsletter was started in 2003, and is intended to provide information on the Palaeontology Department's activities, and includes reviews of research, collections management and conservation issues. If you have trouble accessing the newsletter using this link go to the NHM's home page **http://www.nhm.ac.uk** and enter 'Set in Stone' into the search facility.

**Palaeontolgy - Volumes 1-41 (1957-1998)**
**www.palass.org**
The Palaeontological Association is a registered charity, and since its inception in 1957 it has produced a quarterly journal 'Palaeontology' (bi-monthly since 1998), which publishes original research, including the description of new species. Earlier this year the Association decided to make all of its volumes from 1957 to 1998 (Vols 1-41) freely available over the internet. This valuable resource can be accessed by going to **www.palass.org** and following the relevant links. Within this you will find Clemens 1963 paper on Wealden Mammalian Fossils, which includes the Cliff End Bone Bed (Clemens, W.A. 1963. Wealden Mammalian Fossils. *Palaeontology*, **6**(1), p.55-69). The journals have been scanned in from the originals, so cannot be digitally searched, although the titles can.
The Palaeontological Association has also made all of its Newsletters available from 1995, another valuable source of information.

**Geology of the Wessex Coast (incl.Dorset and East Devon World Heritage Coast)**
**http://www.soton.ac.uk/~imw/index.htm**
This site is produced by Ian West of Southampton University and contains a series of Geological Field Guides to the Wessex Coast of southern England, including East Devon, Dorset, Hampshire, West Sussex and the Isle of Wight. This is one of the world's largest geological web sites, and contains detailed descriptions of stratigraphy, sedimentology, geomorphology and palaeontology, together with extensive bibliographies. Highly recommended, if you are interested in this section of our coastline.

**Proceedings of the National Academy of Sciences (from 1915)**
**www.pnas.org**
Earlier this year the US National Academy of Sciences made all of its Proceedings since its inception in 1915 freely available on the internet (apart from the current year). The Academy publishes its Proceedings weekly, and the archive contains more than 80,000 articles. The archive can be digitally searched, so unless you know the exact paper you want, it may be advisable to use key words in the site's search engine.

**Florissant Fossil Beds National Monument Online Museum**
**http://www.nps.gov/archive/flfo/online_museum**
The Florissant Fossil Beds in Colorado, USA, is one of the world's classic localities, and contains one of the most complete records of an Eocene forest ecosystem (34 million years old), including around 1,700 species of plants and insects. The Florissant Fossil Beds National Monument Online Museum is a comprehensive catalogue of the fossils that can be found there, together with details of its geological history, stratigraphy and palaeontology, as well as pictures of all the fossils.

**Dinosaur Diaries – Newsletter of Dinosaur Isle**
**http://www.dinosaurisle.com/newsletter.aspx**
This is an online newsletter produced by Dinosaur Isle on the Isle of Wight (Dinosaur Isle replaced the Museum of Isle of Wight Geology in 2001). Although when originally proposed the Newsletter was to be aimed at the Island's schools, it was decided that it should also be aimed at a wider audience. It contains museum news and events, and finds from around the Island. It is well worth a look if you are planning a visit to the Isle of Wight.

**Dinowight**
**http://www.dinowight.co.uk**
Still on the Isle of Wight – this site contains a lot of information about the dinosaurs of the Isle of Wight, but I've found that one of its most useful aspects is that if you become a member (which is free) you can download key articles (in pdf format) relating to both the Isle of Wight and Wealden geology and palaeontology.

**The Complete Works of Charles Darwin Online**
**http://darwin-online.org.uk**
This site is hosted by the University of Cambridge, and is the largest collection of Darwin's writings ever published. This site currently offers more than 50,000 pages of text and 40,000 images, and as well as containing all of his published works also includes more than 2,000 letters written by Charles Darwin between 1837 and 1859. The site is being continuously added to and is freely accessible.

**Google Image**
**http://images.google.com**
This is an excellent resource if you need pictures for a presentation, exhibit or article. You can find pictures of just about everything. (Recommended by Jim Priestley)

Editors Note: To test out the site I requested pictures of the Devonian fish *Osteolepis* – it gave me an impressive choice of 176 images.

**Faststone Capture – Programme for use with Google Image**
**www.computeractive.co.uk/2157729** (File size 1.25MB)
Faststone Capture is a free down-load of a short, user friendly program that enables you to capture and file the whole or part of images from your monitor screen. It is useful with the Google Images Program, which usually has several pictures on each page. (Recommended by Jim Priestley)

# GEOLOGISTS' ASSOCIATION LOCAL FIELD MEETINGS – 2007

The Hastings and District Geological Society is affiliated to the Geologisists' Association, and as such members are entitled to go on any of the GA field trips. Bookings must be made through the GA (details below), and the appropriate fee paid. I have only included field trips in the south of England. Details of more distant trips are available at HDGS meetings.

**ENQUIRIES & BOOKINGS** Geoff Swann organises day and weekend meetings in the UK. Michael Ridd is now responsible for overseas and longer trips. **Sarah Stafford at the GA office is responsible for bookings, payments and general administration (tel: 020 7434 9298, fax: 020 7287 0280, e-mail: geol.assoc@btinternet.com).**

You must book through through the GA office to confirm attendance. Please do not contact the field meeting leader directly. Meeting times and locations will be confirmed on booking. These are not normally advertised in advance, as there have been problems with members turning up without booking or paying and maximum numbers being exceeded. ***Field meetings are open to non-members although attendance by non-members is subject to a £5 surcharge on top of the normal administration fee.*** Some meetings may have restrictions on age (especially for under 16s) or be physically demanding. If you are uncertain, please ask.

**PAYMENTS** for day and weekend meetings should be made before attending any field meeting. Cheques should be made out to Geologists'Association Field Meetings. If making multiple bookings, please enclose a separate cheque for each meeting unless you have first confirmed that there are places available. A stamped addressed envelope is appreciated. Please give a contact telephone number and, if possible, an email address and provide the names of any other persons that you are including in your booking. ***PLEASE ALSO PROVIDE AN EMERGENCY CONTACT NAME AND TELEPHONE NUMBER AT THE TIME OF BOOKING.***

There are separate arrangements for overseas meetings.

**TRANSPORT** is normally via private car unless otherwise advertised. If you are a rail traveller, it may be possible for the GA office to arrange for another member to provide a lift or collect you from the nearest railway station. This service cannot be guaranteed, but please ask before booking.

**PUBLIC LIABILITY INSURANCE** for field meetings is provided but personal accident cover remains the responsbility of the participant. Further details are available on request from the GA office.

**SAFETY** is taken very seriously. Should you be unsure about either the risks involved or your ability to participate, you must seek advice from the GA office before booking. Please make sure that you study the risk assessment prepared for all GA field meetings and that you have all the safety equipment specified. You must declare, at the time of booking, any disabilities or medical conditions that may affect your ability to safely attend a field meeting. You may be asked to provide further information on any prescription drugs etc that you may use whilst attending a field meeting. **In order to ensure the safety of all participants, the GA reserves the right to limit or refuse attendance at field meetings.**

**EMERGENCY CONTACT:** if you are lost or late for the start of a meeting, an emergency contact is available during UK field meetings by calling the GA mobile phone (07724 133290). *PLEASE NOTE THIS NEW NUMBER*. The mobile phone will only be switched on just before and during field meetings. For routine enquiries please call the GA office on the usual number.

**TRAVEL REGULATIONS** are observed. The GA acts as a retail agent for ATOL holders in respect of air flights included in field meetings. All flights are ATOL protected by the Civil Aviation Authority (see GA Circular No. 942, October 2000 for further details). Field meetings of more than 24 hours duration or including accommodation are subject to the Package Travel Regulations 1992. The information provided does not constitute a brochure under these Regulations.

## FIELD MEETINGS

### GEOLOGY & FOSSILS OF BRACKLESHAM BAY, WEST SUSSEX
**Leader: David Bone**
**Sunday 18th March 2007**

The foreshore outcrop at Bracklesham is a well-known locality for Eocene shells and sharks' teeth, which may even be found washed out on the beach sand (although our last visit in 2004 was unsuccessful due to rain and gale-force winds that kept the tide in).

Foreshore access is tidally dependent and will not be accessible before mid-afternoon, so members are invited to attend an illustrated talk and display of Bracklesham fossils during the morning, starting at 11:00 am. After lunch, the group will depart for the beach and meet any members who wish to go straight there. Rail travellers can be provided with a lift back to Chichester station.

**Equipment:** Trowel, sample bags and containers for delicate fossil specimens. Warm, waterproof clothing and Wellington boots recommended. Hard hats and high visibility jackets are not required.

**Cost & booking:** Register with Sarah Stafford at the GA office sending an administration fee of £5 to confirm your place. Please indicate whether you wish to attend the morning session or simply join the group on the foreshore.

### THE GEOLOGY OF NEWHAVEN AND PEACEHAVEN
**Leader: Geoff Toye**
**Saturday 14th April 2007**

Geoff led a very successful visit to Eastbourne earlier this year. At Newhaven there will be an opportunity to look at the Teriary beds overlying the chalk at close quarters and the fossils and minerals contained within these.

We will then walk the foreshore from Newhaven Harbour to the steps at Peacehaven, looking at and collecting from the highly fossiliferous chalk of the upper Santonian through the lower Campanian.

**Equipment:** You must have suitable footwear and hard hat.

**Cost & booking:** Numbers will be limited to 20. Further details will be available from Sarah Stafford at the GA office. Register with Sarah sending an administration fee of £5 per person to confirm your place.

### THE GEOLOGY OF SOME WEST SURREY CHURCHES
**Leader: Prof John Potter**
**Saturday 12th May 2007**

Continuing this popular series of annual excursions, the rocks and structure of seven early churches in West Surrey will be examined and related to the local geology. These include some of the churches that initiated John's enthusiasm for ecclesiastical geology 35 years ago – geological influences on early settlement, unusual building stones, double-stacked chancels and more. Lunch will be taken at a village hostelry. Travel will be by car with members sharing to reduce vehicle numbers as necessary.

**Equipment:** No hammers please, but do bring a quality hand lens and binoculars.

**Cost & booking:** Numbers will be limited to 28. Further details will be available from Sarah Stafford at the GA office. Register with Sarah sending an administration fee of £10 per person to confirm your place.

**WEALDEN EXCURSION**
**Leaders: Pete Austen, Richard Agar, Dr Ed Jarzembowski and Geoff Toye**
**Saturday 21st July 2007**

This trip continues the popular annual excursion to working pits in the Weald Clay of south-east England, where the GA has already participated in some superb fossil finds. The venue(s) will be confirmed later so as to take advantage of conditions at the time. Numbers may be limited.

**Equipment:** You must have suitable footwear, a high visibility jacket and hard hat.

**Cost & booking:** Further details will be available from Sarah Stafford at the GA office. Register with Sarah sending an administration fee of £5 per person to confirm your place.

## Smokejacks Fieldtrips 2007

Two further visits are planned to Smokejacks in Surrey. The trips are being run as part of the **Kent Geologists' Group** field programme for 2007. See page 18 for details of the geology and palaeontology of the site.

N.B. Parts of the pit are still flooded – please take care.

Dates: Sunday 29th April 2007
Sunday 9th September 2007

Meet: Meet at 10.30 a.m. in the car park at Smokejacks Brickworks (**Wienerberger Limited – Ewhurst Works**).
Smokejacks is just south of Walliswood (4 km southwest of Ockley), Surrey.
O.S. map 187 – 1:50,000 series
Grid reference TQ 116 372

Equipment: **Hard hats and reflective jackets are compulsory**. Eye protection, hammer, chisels, wrapping material for specimens, handlens and boots suitable for claypit. Packed lunch. Sun protection is advisable if it is a hot day, plus sufficient drink.

Risk Assessment: All attendees must familiarise themselves with the **Risk Assessment** for the site. If you have not seen a copy please contact Peter Austen (details below). Copies will be available on site.

Cost: There will be a small charge of £2 per person to cover administration for non Kent Geologists' Group members.

Contact: Please contact Peter Austen at least 10 days before the event with details of numbers attending.
Peter Austen on 01323 899237
e-mail: PJAusten@ukgateway.net

Future Visits: If you wish to be kept informed of future visits to Smokejacks, please send your e-mail address to me at PJAusten@ukgateway.net

# GEOLOGICAL SOCIETY WEBSITES

## Geologists' Association Local Groups

Dorset Geologists' Association Group . . . . . http://www.dorsetgeologistsassociation.com
Farnham Geological Society . . . . . http://www.farnhamgeosoc.org.uk
Harrow & Hillingdon Geological Society . . . . . http://www.hhgs.org.uk
Kent Geologists' Group . . . . . http://www.kgg.org.uk
Mole Valley Geological Society . . . . . http://www.radix.demon.co.uk/dendron/mvgs
North Staffs Local Group . . . . . http://www.esci.keele.ac.uk/nsgga
North Wales Geology Association . . . . . http://www.ampyx.org.uk/cdgc
South Wales Local Group . . . . . http://www.swga.org.uk
West of England Local Group . . . . . http://www.wega.org.uk

## Geological Societies affiliated to the Geologists' Association

Carn Brea Mining Society . . . . . http://www.carnbreaminingsociety.co.uk
Cheltenham Mineral & Geological Society . . . . . http://www.geocities.com/cmgs_99
Craven & Pendle Geological Society . . . . . http://www.cpgs.org.uk
The Dinosaur Society . . . . . http://www.dinosaursociety.com
Earth Science Teachers Association . . . . . http://www.esta-uk.org
East Herts Geology Club . . . . . http://www.ehgc.org.uk
Essex Rock and Mineral Society . . . . . http://www.erms.org
Hastings & District Geological Society . . . . . http://www.hastingsgeolsoc.org.uk
Hertfordshire Geological Society . . . . . http://www.hertsgeolsoc.ology.org.uk
Hull Geological Society . . . . . http://go.to/hullgeolsoc
The Jurassic Coast . . . . . http://www.jurassiccoast.com
Kent RIGS Group . . . . . http://www.kentrigs.org.uk
Leeds Geological Association . . . . . http://www.leedsgeolassoc.freeserve.co.uk
Leicester Literary & Philosophical Society – Geology Section (C) . . . . http://www.charnia.org.uk
Liverpool Geological Society . . . . . http://www.ljmu.ac.uk/lgs
Manchester Geological Association . . . . . http://www.mangeolassoc.org.uk
Open University Geological Society . . . . . http://www.ougs.org.uk
Reading Geological Society . . . . . http://members.lycos.co.uk/rgsberks
Shropshire Geological Society . . . . . http://www.shropshiregeology.org.uk
Sidcup Lapidary & Mineral Society . . . . . http://web.ukonline.co.uk/slm.s2
Southampton Mineral & Fossil Society . . . . . http://members.lycos.co.uk/SMFS
Tertiary Research Group . . . . . http://www.trg.org
Warwickshire Geological Conservation Group . . . . . http://www.wgcg.co.uk
West Sussex Geological Society . . . . . http://www.wsgs.tk
Yorkshire Geological Society . . . . . http://www.yorksgeolsoc.org.uk

All sites were valid as at 18th November 2006 – Peter Austen