Science at the Museum

The Natural History Museum is home to more than 300 scientists. Many of them are leading experts in their field – their research is carried out all over the world, from finding ways to prevent the spread of fatal diseases to monitoring populations of rare species. Here we look at just one aspect of the work being carried out by each of our scientific departments ...

Entomology earthworm survey

with Dr David Jones

This spring, the Museum's Entomology Department together with Imperial College and the Open Air Laboratories (OPAL) project will be running a national earthworm survey. Charles Darwin, the scientist who developed the theory of evolution, studied earthworms. He called them nature's plough because they churn up the soil. Their burrowing gives the soil a loose, open structure and this allows water and air to penetrate deep into the soil, making it easier for plant roots to grow through the soil.

All earthworms eat dead vegetation. Some species come to the soil surface at night to pull fallen leaves underground and feed on them in their burrows. Other species stay underground, swallowing large quantities of soil to digest the tiny fragments of dead plants that it contains. A few species, including those found in compost heaps, live in fallen leaves and feed on rotting vegetation at the soil surface.

The vegetation and soil eaten by earthworms are excreted as a fine paste called a cast. Some species deposit their casts on the soil surface and some leave them underground. Casts contain minerals and plant nutrients that are absorbed by plant roots. So the feeding and burrowing of earthworms helps to keep soils healthy, fertile and productive.


Lob worm *Lumbricus terrestris*
Green worm *Allolobophora chlorotica*
Grey worm *Aporrectodea caliginosa*

Why the survey?

Well, not much is known about where the 26 species of British earthworms live. The aim of the survey is to discover whether different species live in different habitats such as woodland, grassland or gardens, and to investigate whether they prefer different types of soil. Very rich, fertile soils can have more than 500 earthworms per square metre, while other types of soil may have very few. You can help the project by looking for earthworms in your garden and contributing your findings to our survey at **www.opalexplorenature.org**

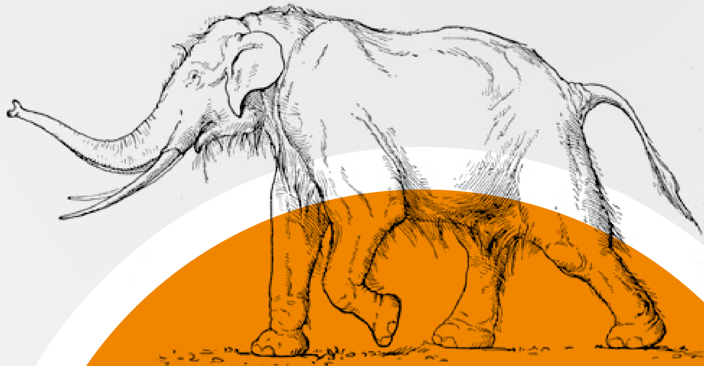
Palaeontology Taiwanese elephant teeth

with Professor Adrian Lister

This is the mandible (lower jaw bone) of an extinct elephant – the so-called straight-tusked elephant *Palaeoloxodon*. The specimen was donated to the Museum by Chun-Hsiang Chang of the National Museum of Natural Science in Taiwan.

This bone was dredged from under the sea that separates Taiwan from mainland China. Probably between 70,000–10,000 years old the straight-tusked elephant lived in the area when global sea-levels were much lower and there was sometimes a land bridge between Taiwan and the mainland.

My colleagues and I have been researching the mandible and others like it so we can understand the evolution of the elephant family. For example, the number of enamel ridges on the teeth changes through time as the animals adapted to eating different kinds of vegetation – grass rather than tree leaves. We take lots of measurements and compare the specimens from different geological levels and regions. So far, almost all research has been carried out on elephant fossils from Europe – the new material allows us to look at the Far East, too.



Palaeoloxodon...

stood up to four metres tall – a lot larger than elephants today. It browsed the leaves of trees and shrubs using its huge molar teeth that were up to 40 centimetres long.

You can see one of these molars in the mandible below.

Taenia saginata, beef tapeworm

Zoology tapeworms

with Dr Peter Olson

At one point or another every student of biology will have seen a tapeworm – a long, thin segmented worm from someone's or something's gut. For those who haven't, imagine a very long ribbon or a long, flattened bendy straw.

This image of the tapeworm is based on the genus *Taenia*, which live as larvae in the flesh of pigs and cattle – but there are more to tapeworms than that. In fact, there are more than 15,000 species of tapeworm. They infect every major group of vertebrate – fish, birds and mammals and they range in size from a few millimetres to more than a metre. But where did they come from?

Our research shows tapeworms evolved from free-living (non-parasitic) flatworms that first became parasites of fishes either by being eaten by fishes directly, or by eating aquatic invertebrates, such as zoo-plankton, which had tapeworms inside them. Tapeworms later acquired land-dwelling vertebrates, such as foxes and sheep, as hosts by adapting their life-cycles. By parasitising insects, such as beetles, they worked their way into the food chain. Even though tapeworms evolved to live in the gut of land animals, today you can still find them living in the gut of nearly every individual shark and ray in the ocean.

The evolution of a parasitic life-style required major changes for the tapeworm. They evolved a segmented body with many sets of reproductive organs (both male and female), which allows them to produce hundreds of thousands of eggs each day. Very few of these eggs survive to become adults, but the huge amount of eggs produced means a few survivors are guaranteed.

However, there are tapeworm groups that do not have segmentation (like their free-living ancestors). There are also other versions of the typical tapeworm form that exist. These are interesting to scientists because they provide clues as to how the early tapeworms evolved.

I am exploring how developmental genes contribute to producing segments in tapeworms. This will help us compare how these genes behave in groups that lack the segmentation which is seen as the hallmark of the tapeworm body.

They're not noodles!

Azorina vidalii – only representative of the only endemic genus of flower

Botany botanical explorations in the Azores

with Dr Fred Rumsey

The Azores is a group of nine small islands, in the Atlantic Ocean, roughly halfway between Europe and North America. The distance between the two furthest islands Santa Maria in the east and Flores in the west is 615 kilometres. Remote islands hold a fascination for biologists because they support endemic species – ones that live nowhere else. These may be old relicts, finding a safe haven away from a changing world, but most are actually newly formed species. Isolated from similar things and with little competition they can develop in strange new ways. These processes are not unique to islands, just easier to study there.

Last summer Mark Carine and I linked up with colleagues from the University of the Azores to study some of their rarest endemic plants. Fighting our way through dense forest and climbing down the inside of old volcanic craters we wanted to collect material to help us better understand how these special plants evolved.

We also wanted to try to locate some of the rarest plants and help local botanists conserve them. This work is being co-ordinated by Project Veronica – named after the small blue flower that was thought to be extinct until recently rediscovered on the steep outer slope of an extinct volcano on the smallest island, Corvo.

We were lucky enough to find a new site for this and also discovered a new species of fern, although careful study within the Museum's herbarium shows it had first been collected, but misidentified, on the same island over 160 years ago. This just goes to show how much more work there is to be done on the Azores – we just don't know what amazing secrets we might yet discover.

The mysterious Azores...

as Darwin found in the Galapagos, each island of a group usually has its own distinct species or varieties. In the Azores most endemics occur on many islands across the whole island group.

Mineralogy comets

with Anton Kearsley

Comets are one of the most spectacular sights in the night sky. For most of their long, long lives they slumber far away in freezing space, beyond Mars, Jupiter or even Neptune. Only when they are thrown closer to the Sun do they wake into glorious brightness. They cannot survive in the warm inner part of the solar system, because their icy body is eaten away – often causing them to break up into clouds of streaming gas and dust. Then they just fade away.

When the NASA *Stardust* spacecraft brought back to Earth samples from comet Wild 2, scientists expected to see the most ancient material in the solar system – even some from before our star – the Sun – formed.

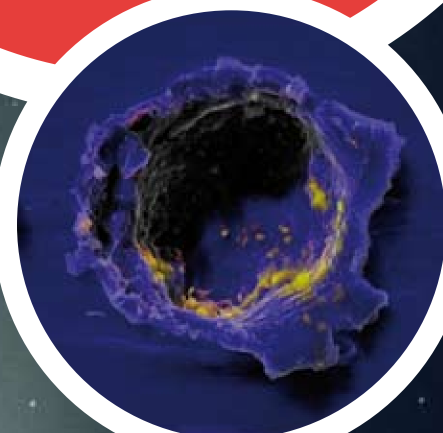
To the surprise of scientists at the Museum and throughout the world, instead of ancient frozen dust from the galactic space between stars, the comet contained crystals that were formed in the fiery glowing disk around the infant Sun, around four and a half billion years ago.

I have been trying to understand the structure of the comet dust by using high magnification pictures of tiny dust impact craters like the picture on the right shows, taken on the scanning electron microscopes at the Museum.

This picture shows that instead of loose fluffy dust, this comet contains dense grains – similar to the stuff meteorites are made of – that we thought came from rocky asteroids not from icy comets like Wild 2.

So – maybe comets and asteroids aren't really as different as we thought. Watch this space for new developments...

This is a tiny crater – just 1/20 of a millimetre across (50 would fit across a typical grain of sand). It was made by the high-speed impact of a grain of dust on the *Stardust* spacecraft when it passed through the dust around the comet Wild 2, over 200 million kilometres from Earth. The picture was taken on a scanning electron microscope. The yellow colour picks out the remains of minerals from the comet dust grain.



The Wildlife Garden in winter

At the end of October when the gates of the Wildlife Garden close to visitors, the winter work of the gardeners begins. It's also a very busy time for many of the garden's animal residents.

grey squirrel

beech trees

frog in the fallen leaves

In early autumn, fruits and berries in the Wildlife Garden begin ripening and the birds and small mammals that make their home here start collecting food before the winter food shortages begin. The first berries to ripen are rowan – they don't stay on the trees for long, as birds swoop in to gobble up the juicy orange-red fruits. In the hedgerows, blackbirds feast on dark blackberries and bluish-purple sloes. Dog rose and guelder rose flash their bright-red tempting hips and berries. Hazel nuts and acorns are collected by squirrels, wood mice and jays – some are stored and some are eaten – the remains of cracked shells are often found as evidence.

The leaves on the trees gradually change colour, and by November, the different shades of autumn transform the garden from the deep green of late summer to a rich palette of yellow, orange, pink and brown. The butter-yellow lime leaves are the first to fall, leaving the tree to stand bare while others are still fully clad in their leaves. Beech leaves turn a rich toffee colour, field maple and hornbeam golden yellow and rowan pink and red. The London plane trees towering above the garden begin to turn orange-brown.

We start leaf raking in October to keep the paths clear for visitors and to protect the grassland. Fallen leaves are left in hedges and woodland to break down naturally – they are helped by invertebrates that live in the leaf litter. The leaves provide refuges for animals such as toads and frogs, too. Under the London plane trees, plane leaves are carefully removed. Unlike the leaves of our native trees, plane leaves take years to break down. If left, they would smother other plants and there would be no primroses, bluebells or other flowers in spring. The large leathery leaves are shredded and scattered back into the woodland habitats. Shredded leaves break down more quickly and spring flowering plants can push their way up through them, into the light.

Winter work includes feeding birds with bird seed mix and peanuts, checking nest boxes and making any necessary repairs to the moorhens' pond island. By January, when all the fruits and nuts have been removed by birds and squirrels, or fallen and collected by smaller animals it is safe to prune hedges and coppice. Coppicing is an ancient way of harvesting woodland. It entails cutting small trees such as hazel and willow to the base. In spring, small shoots appear from the base continue to grow. After a few years, the stems will have grown tall enough for cutting again. The long cut stems are used for making woven fences around the meadow.

We are careful to make sure all our winter work is finished by the beginning of March. This is when birds begin to look for places to build their nests and so trees and shrubs should not be disturbed. Although the garden gate is closed during the winter, you are welcome by appointment to visit the garden. If you'd like to visit us during the winter, please ask at the information desk.