



VOLCANO SPREADS FINE ASH OVER PATAGONIA

TEN THOUSAND years after its last eruption, the Chaiten volcano in Chile recently exploded spraying fine dust across Patagonia in South America.

Scientists from the University of Oxford and Argentinean colleagues have produced a remarkably detailed picture of the spread of fine ash following the May eruption.

David Pyle from Oxford said,

'Eruptions in southern Chile leave fine ash across Argentinean Patagonia. This can severely affect airports and grazing land.'

In early June, a team led by David's colleague Seb Watt drove 7000 kilometres across the region, plotting the fallout.

The group has produced maps of ash thickness and has used satellite pictures to follow the path of the ash cloud in the days after the eruption.

The ash extends for 175,000

square kilometres, an area over eight times the size of Wales.

The next goal is to use the new information to test the accuracy of current ash-deposition models and to discover what triggers these eruptions. They want to know why the style of this eruption was so similar to that of the last known eruption 10,000 years ago.

The work was made possible by a NERC urgency grant.

In brief

Annual report

NERC's annual report was published on 31 August. To order a copy email requests@nerc.ac.uk

Olympic silver

NERC-funded postdoctoral research fellow Joshua West from the University of Oxford, won a silver medal in the men's-eight rowing at the Beijing Olympics.

Science delivery director

Dr Philip Newton was appointed NERC's first Director of Science Delivery in July.

New chief scientist at Met

The National Centre for Atmospheric Science's Director of Climate Research, Julia Slingsby OBE, has been appointed Chief Scientist at the Met Office. Julia will be responsible for leading the strategic direction of weather and climate change research at the Met Office.

Life found 1600 metres below seafloor

THE KNOWN limits for life on Earth were extended to new record depths with the discovery of a community of cells thriving in hot sediments 1626 metres below the seafloor. The deepest living cells were previously found at 842m.

The scientists discovered two types of simple cells in kilometre-long rock cores sampled in the North Atlantic. Some cells were still dividing, revealing a successful ecosystem living in

extreme conditions.

The cells do not have nuclei, like the cells that make up animals and plants. They are classified as *Archaea*, a group similar to bacteria that includes organisms capable of living in harsh environments, known as extremophiles. The microbes survive in the deep ocean floor by feeding on methane gas produced by high-temperature chemical reactions.

'Even the deepest samples

are still below the known upper temperature limit for life – about 120°C. So, by having a deep energy source such as methane available, you would expect live extremophiles in these sediments,' said John Parkes from Cardiff University and one of the co-authors of this study.

The research suggests that, as long as energy sources are available, microbes will probably be found at even greater depths.

Living With Environmental Change director appointed

LORD SELBORNE, the chairman of the Living With Environmental Change programme board, has announced a director to lead the programme. Professor Andrew Watkinson, currently Director of the Tyndall Centre for Climate Change Research and a Professor in the School of Environmental Sciences at the University of East Anglia, will take up the new position. The directorship will run for five years initially.

Rainforest canopy reveals its secrets



The NERC/Met Office BAe 146 research aircraft swooping low over Malaysian rainforests.

A RESEARCH expedition involving 60 scientists and support staff descended on the rainforests of the remote state of Sabah in Borneo in July. The team used a low-flying research aircraft and ground-based instruments to investigate how the rainforest influences the chemical composition of the air above it.

The group, made up of scientists from the UK, Malaysia and Italy, believe the campaign may be the first to link closely such detailed ground-based and airborne measurements simultaneously over a rainforest.

Pilots swooped low over the canopy following a flight path that took them below the forest on surrounding hills (pictured).

The research, which is part of the £1.9m three-year OP3

project, short for 'Oxidant and particle photochemical processes above a South-east Asian tropical rainforest', was led by Nick Hewitt, professor of atmospheric chemistry at Lancaster University.

The consortium based itself at two sites: the Bukit Atur Global Atmospheric Watch research station in Danum Valley and Kota Kinabalu international airport, a short flight from Danum Valley.

They measured emission rates of chemicals coming from the forest canopy, in particular isoprene, a volatile organic compound. Scientists think isoprene protects plants against stress, for example heat stress on hot days, but it is also an important component of global atmospheric chemistry. The

measurements will be used in models of local, regional and global atmospheric chemistry and climate.

'We want a better idea of what happens to these reactive gases in the atmosphere, how they influence ozone and other oxidants, and whether they form particles in the atmosphere,' said Nick.

The consortium has already made a 'significant' finding.

'We saw big differences between the atmospheric composition above rainforests and the composition over oil palm plantations,' reported Nick.

Oil palm, a good source of food and biofuel, is a big industry in the region. Plantations are replacing rainforests throughout the tropics. The implications of the research will become clearer

in the next 12 months.

The team think it likely the project will inform Malaysian scientists and planners on the connections between South-east Asian tropical forest and climate, supporting Malaysian research and policy on sustainable forest management.

The OP3 consortium involves ten Malaysian institutes and scientists from the universities of Lancaster, Leicester, Cambridge, York, Leeds, Manchester and East Anglia and the Centre for Ecology & Hydrology, Edinburgh. It is due to finish in 2010.

The research aircraft, a BAe 146, is operated by NERC's Facility for Airborne Atmospheric Measurements, funded jointly by the Met Office and NERC.

Efficient carbon dioxide to methanol converter found

A GROUP of scientists have found a catalyst that breaks down carbon dioxide to formate, which can be re-used as a fuel. The catalyst significantly reduces the energy needed for this chemical reaction.

The research, published in the US journal *Proceedings of the National Academy of Sciences*, states the reaction 'occurs under thoroughly mild conditions, and formate is the only product'.

Carbon dioxide is a stable molecule. It takes a lot of energy to transform it back into molecules like formate or methanol.

But the catalyst, a tungsten-containing formate dehydrogenase enzyme, demonstrates that it is possible to convert carbon dioxide back into a fuel efficiently. While the

enzyme is not a realistic target for commercial exploitation, the research could lead to synthetic catalysts to sequester carbon dioxide and provide a source of renewable energy.

The researchers point out that 'formate is a viable energy source in its own right as well as an industrially important feedstock and a stable intermediate in the conversion of CO₂ to methanol and methane.'

The team, which was led by scientists from the Medical Research Council Dunn Human Nutrition Unit, carried out the reactions in a solution that included CO₂, H₂CO₃ and HCO₃⁻. British Antarctic Survey scientists measured how efficient the production of formate was in the reactions.

LIFE IN THE COLD

FROM bacteria to giant octopuses, the most comprehensive survey of marine life in a polar sea has been published in a special issue of the international journal *Antarctic Science*.

The survey was part of the 2006 BIOPEARL research expedition in the Scotia Arc region of the South Atlantic Ocean. The arc is a chain of islands and undersea ridges that links the mountains of the Antarctic Peninsula to Tierra del Fuego and the Andes in South America.

Lead author David Barnes from the British Antarctic Survey, said, 'The BIOPEARL expedition was a fantastic project. We have learnt more about continental slope biology from this one expedition than has been achieved in the previous half a century.'

The BIOPEARL expedition is part of the Census of Antarctic Marine Life.

that climate models appear to underestimate the increase in intensity of the heaviest rain events in response to warming.'

The research was published in the journal *Science Express*.



Major new programmes announced

BY THE CLOSE of 2008, NERC will launch four large-scale research programmes: the Changing Water Cycle (£11m), Ocean Acidification (£7m), Storm Risk Mitigation (£5m) and Ecosystem Services for Poverty Alleviation (£10m). (See Leader on page one.)

These programmes are the first major initiatives following the launch of the new strategy *Next Generation Science for Planet Earth*.

They are part of a wide-ranging set of new schemes. An Environmental Nanoscience programme will study the environmental impacts of nanoparticles in water, soils and air, and another programme will focus on understanding the consequences of using land for renewable energy production.

Quantifying uncertainty in predictions of regional and local climate change, and carbon capture and storage are the final two to be announced.

Full details: www.nerc.ac.uk

Competition

The Census of Marine Life

The lightless depths of the oceans are home to some of Earth's strangest and most beautiful creatures but remain among its least-studied places.

The Census of Marine Life project, with a European office at NERC's collaborative centre the Scottish Association of Marine Science, will change that.

Over ten years, researchers from more than 80 nations aim to catalogue and explain the diversity of ocean life, including the denizens of the abyss.

We have three copies of *Deeper Than Light*, co-authored by Bhavani Narayanaswamy, European project officer for the census, to give away. It is packed with stunning photos of the deep-sea environment, and can be bought for £7 by emailing DESEO@sams.ac.uk. To enter,

answer the question on the Planet Earth online website: www.nerc.ac.uk/planetearth. Closing date: 1 December.



'Distinct link' found between storms and temperature

SCIENTISTS have found a 'distinct link' between the number of extreme rainstorms and temperature.

Richard Allan from the Environmental Systems Science Centre at the University of Reading and Brian Soden from the University of Miami used satellite records stretching back 20 years to investigate changes in climate associated with the naturally-occurring El Niño phenomenon. The satellite data confirm climate model predictions that higher temperatures seem to be linked to a larger number of intense tropical storms.

Brian, an associate professor at the Rosenstiel School of Marine & Atmospheric Science, said, 'A surprising result is

Espresso science: coffee granules reveal how plague spreads in wild animals

Managing bubonic plague in wild gerbil populations: large-scale flea control in Kazakhstan, central Asia.



DISEASE outbreaks are usually explained by abundance theory – as populations grow, more individuals are likely to bump into one another and so disease will spread.

But when it comes to the bubonic plague-harboring giant gerbils of Kazakhstan, it seems another mathematical concept – percolation theory – may better explain outbreaks.

In Kazakhstan and elsewhere in central Asia, the plague bacterium *Yersinia pestis* – the source of human cases of bubonic plague – still circulates in wild populations of gerbils and other small mammals. At a workshop on plague thresholds funded by NERC for the Environment and Human Health programme, researchers wondered aloud whether the key for disease outbreaks

was not abundance thresholds, but percolation thresholds. Percolation theory allows mathematicians and material scientists to work out how something slips through a porous material, like hot water through coffee granules in an espresso machine.

After the meeting, the researchers contacted percolation expert Peter Trapman from the University Medical Center in Utrecht, Netherlands. This new line of enquiry led to a paper in the journal *Nature*.

Co-author and Deputy Head of the School of Biological Sciences Michael Begon was at the workshop. 'Instead of thinking of populations in terms of critical densities of individuals, percolation theory imagines points fixed in space and that there are paths between them.'

'The points are the gerbil colonies.'

Gerbil burrow systems in central Asia interconnect and spread from the Chinese borders to the Caspian Sea across vast tracts of desert. Earth observation satellites can pick them out because inhabited burrows create great discs of bare earth above, 30 metres in diameter. Scientists can use these to make maps of the various clusters.

'Imagine a path from colony to colony,' continued Michael.

'What we've got is a lot of addresses, but not all are inhabited.'

'Inhabited burrows stand out because the vegetation surrounding them has been kept back by the gerbils.'

'What we've found is that, up to a point, it does not matter about the size of a family of gerbils,

what matters is how connected they are to other families.'

Below the threshold, plague may pass from family to family but is always aborted. Above the threshold, plague sweeps through the whole lot of interlinked burrows.

It turns out that outbreaks only occur when family groups of gerbils live in more than one third of burrow systems. Below this number – or percolation threshold – plague remains contained.

The scientists believe this is the first time percolation theory has successfully described the natural dynamics of an infectious disease. The team was greatly aided by the so-called Plague Archive, the Soviet Union's meticulous record of plague in wild animals kept after World War II.

'Freeze-dried fossils' help date rapid climate shift

EXCEPTIONALLY well-preserved fossils of insects, mosses, freshwater shrimps and algae have been found in Antarctica's McMurdo Dry Valleys in the Transantarctic Mountains. The haul represents the last vestiges of a tundra ecosystem in the southernmost part of the continent.

The fossils date back 14.07 million years. Shortly afterwards, geologically speaking, temperatures plummeted 8°C bringing a full polar climate to Antarctica: sediments dating back 13.85 million years – 200,000 years later – contain no fossils.

The exact cause of this dramatic climatic shift, one of the most significant in the

last 65 million years, remains a mystery.

The fossils are the first to be found in the area even though other scientific expeditions have been visiting the region for a century. They show that 14 million years ago, the climate in the region was closer to that of the southern tip of South America today. Since this time, Antarctica has been in a deep freeze.

An international research team led by David Marchant, an associate professor of earth sciences at Boston University, and including Melanie Leng from the NERC Isotopes Geosciences Laboratory, reported the discovery in the US journal *Proceedings of the National Academy of Sciences*.

PREDATORY ALGAE DISCOVERED

IF YOU MENTION carnivorous plants, most people will think of Venus flytraps snaring unwary insects. But NERC-funded researchers have discovered a taste for flesh isn't confined to big multicellular plants – it exists even on a microscopic scale.

Mike Zubkov from the National Oceanography Centre, Southampton, and Glen Tarran from Plymouth Marine Laboratory noticed the phenomenon while working aboard the NERC research ship RRS *Discovery* in the North Atlantic. *Nature* published the research in August.

Until now scientists thought another kind of microbe, protozoa, were responsible for consuming most marine bacteria. In fact, plants seem to eat far more.

'We were amazed to find

that the algae we studied were eating bacteria,' said Mike. 'What is more, algae were doing a lot of it. The combined bacterial consumption by the algae equalled or exceeded the bacterial consumption by protozoa.' The researchers were able to observe this by dosing bacteria with small amounts of radiation. When algae ate the bacteria, they took on some of that radiation themselves.

The sea contains countless trillions of these tiny algae, which were previously thought to get all their energy from sunlight through photosynthesis. But bacteria account for an estimated quarter of the plants' overall energy needs.

Mike will return in October with a six-person team to evaluate the significance of the discovery.

New supercomputer available to climate researchers

The Met Office has signed a contract with IBM for its next-generation supercomputer that will underpin its weather forecast and climate research programmes until 2013. One part of the four-machine system will be jointly funded by NERC (£7.5m over five years).

The new system will allow greater use of ensembles – multiple simultaneous weather or climate forecasts. This could lead to earlier warning of low probability, high-impact weather.

A vision for science and society: consultation

Everyone has an opinion on how scientists communicate with government, industry, the media and the public. The Department for Innovation, Universities and Skills wants people to get these opinions off their chests in a consultation on its vision for science and society. Closing date: 17 October.

<http://interactive.dius.gov.uk/scienceandsociety/site/>

£2000 grants available for science communication

National Science and Engineering Week is one of the world's largest public engagement programmes for scientists. In 2008, participation rose to 1.4 million people, according to the British Association for the Advancement of Science.

With no restrictions on the topics covered, the audience or venue, the resulting programme is eclectic and often thrilling.

Scientists and PhD students funded by the research councils can apply for grants of up to £2000 to develop ideas for the week. Closing date for applications is 13 October.

www.rcuk.ac.uk/scienceweek

Sons lose out to daughters of parasite-ridden mothers

PARASITES reduce breeding success in seabirds by hampering the mothers' attempts to rear their sons, say researchers.

It seems internal parasite infection hinders foraging mothers during the critical nesting period. This is a time when European shag chicks need food most. Males suffer more because they grow larger than their sisters.

The research on breeding on the Isle of May off the east coast of Scotland was led by biologists from the University of Edinburgh and the Centre for Ecology & Hydrology (CEH) and published online in *Science*.

New Council members

SCIENCE MINISTER Ian Pearson has appointed three new members to NERC's governing Council. Rowan Douglas, the managing director of Willis Analytics for Willis Re, the world's third largest insurance and re-insurance broker; Charles Godfray, professor of zoology at the University of Oxford and a fellow of the Royal Society; and Andrew Watson, professor at the School of Environmental Sciences, University of East Anglia, and a fellow of the Royal Society.

ROBOT SUB INVESTIGATES SEAFLOOR CANYONS

THE LATEST deep-diving robot submarine from the Autosub team, Autosub6000, successfully returned from a 24-hour mission deep beneath the surface of the Atlantic Ocean.

Autosub6000 dived almost three miles to investigate a submarine canyon north of the Canary Islands.

The results from the expedition were spectacular three-dimensional images showing holes in the seafloor the size of a football stadium formed by giant submarine landslides that flowed for up to 1000 kilometres.

The expedition on board NERC's research ship the RRS *James Cook* investigated potential threats from tsunamis, giant landslides and earthquakes to coastal communities in western Europe.

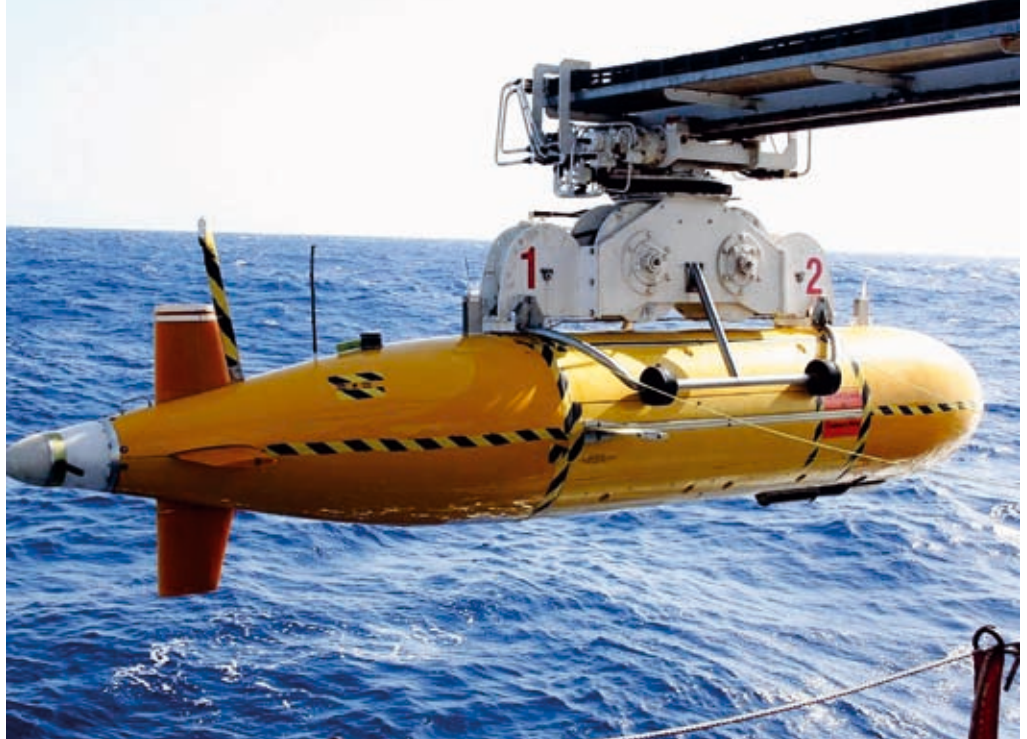
Team leader Steve McPhail, from the National Oceanography Centre, Southampton, (NOCS), said, 'Autosub is a completely autonomous robot. There are no connecting wires with the ship and no pilot. Once programmed, it dived down to the ocean floor and completed its mission without any further intervention.'

The research team also sampled seafloor sediments to establish how often landslides occur in different areas of the deep ocean.

Chief Scientist Russell Wynn from NOCS said, 'We have found that giant landslides are actually quite rare around the Canary Islands, with no major activity in the last 15,000 years.'

Autosub6000's next mission is to search for evidence of the 1755 Lisbon earthquake. The earthquake killed over 10,000 people, and generated a tsunami that reached south-west England.

Autosub being launched.



KT Tunstall and Jarvis Cocker visit Disko Bay

AS *Planet Earth* went to press, songwriters Jarvis Cocker and KT Tunstall, comedian Marcus Brigstocke and BBC journalist Quentin Cooper were to join glaciologists, geoscientists and oceanographers from three NERC centres on an expedition

to the aptly named Disko Bay in northern Greenland.

Disko Bay is the site of the largest and fastest-moving glacier in the world. The research and educational expedition will include 40 architects, artists, writers, filmmakers, musicians and scientists.

The group plan to use a converted Russian science vessel, the *Grigory Mikheev*, for the expedition, scheduled to begin on 25 September.

The voyage is the seventh Cape Farewell expedition. They have already led to educational resources, books and a film for the BBC.

Antony Gormley, Rachel Whiteread, Ian McEwan and Vikram Seth have joined previous voyages.

Carol Cotterill from the British Geological Survey, Simon Boxall from the National Oceanography

Centre, Southampton, and Emily Venables from the Scottish Association for Marine Science are due to join the crew, which finishes on 6 October.

More information: www.nerc.ac.uk/planetearth



Brian Rasic/Richard Young/Rex Features



A map set in stone

A PROJECT to create electronic maps of the Earth's rocky structure promises to do for geology what Google Earth has for the land's surface.

Called OneGeology, it's the biggest digital geological mapping project ever and shows the Earth stripped of plants, water, soil and built structures to show the rock beneath. The www.onegeology.org website makes this information freely available to everyone.

'Knowledge of the rocks we all live on has become increasingly important, and sharing that knowledge at a time of global environmental change is crucial,' said Ian Jackson, chief of operations at the British Geological Survey and co-ordinator of the project.

He added that sharing geological information will help with problems ranging from predicting natural disasters to finding valuable resources and

discovering possible underground sites to store CO₂.

Visitors can export data from the website for layering onto Google Earth and similar applications. They can do this because OneGeology's creators have also devised a new web programming language to allow nations to share geological data with each other and the public.

The OneGeology project is the fruit of collaboration between geologists and computer

scientists in 79 nations.

Timed to coincide with the United Nations International Year of Planet Earth 2008, the project attracted a great deal of media attention worldwide. It was the subject of 322 online news articles, and was covered by major publications on every populated continent.

The project's YouTube channel, www.youtube.com/onegeology, has had 25,000 visitors.

UK SCIENTIST EXPLORES CAUSES OF SICHUAN EARTHQUAKE

A NERC-FUNDED scientist has returned from a field trip to China to examine the causes of the 12 May earthquake that killed more than 69,000 people.

Alex Densmore, associate director of hazard research at the Institute of Hazard and Risk Research and Department of Geography at Durham University, was the first UK scientist to visit the area to explore the earthquake's causes. He says we still don't know when or exactly where disaster will strike next in the region, but we do know which areas are at most risk. This knowledge could save lives by helping planners avoid building on dangerous ground.

'It was very noticeable that

buildings 50 or even ten metres on either side of the surface rupture were often damaged but still standing,' he says. 'Buildings that lay directly on the rupture collapsed almost without fail. If you could prevent building directly on top of active faults, you could save a lot of lives.'

He adds that authorities now have a unique opportunity to do this. Reconstruction efforts are picking up pace, and Densmore believes Chinese officials would be well-advised to consider imposing buffer zones around faults. Given that they're also considering proposals to move all the survivors of some of the hardest-hit towns to new settlements, such buffer zones

should not be prohibitively expensive.

Because of very limited historical records of previous earthquakes in the area, it's not possible to predict when the next event will happen.

Among the expedition's goals was to find out whether the earthquake activated faults that geologists had already mapped, or whether it created new ones. The answer was a bit of both, though Densmore says that the area's intensive land use and dense development complicated the process of understanding its fault lines.

Apart from the earthquake itself and its aftershocks, now dying down, the landslides it

caused are still causing problems. Heavy rain is still triggering these events, blocking roads and hampering reconstruction efforts. The landslides are also dumping tonnes of sediment in rivers, causing riverbeds to rise as much as three metres already and inundating low-lying settlements. The sediment will take decades to work its way out of Chinese rivers, and could disrupt dams and hydro power stations.

Densmore worked on the project alongside colleagues from the Chengdu University of Technology, the Seismological Bureau of Sichuan Province and Shell UK. He now plans to write up the results of the research for publication.

ACID RAIN CUTS METHANE EMISSIONS

METHANE emissions from rice plants fall by almost a quarter during a crucial growth period when treated with simulated acid rain, say scientists in the *Journal of Geophysical Research*.

Emissions dropped 24 per cent during the grain filling and ripening stage of the rice season. This stage accounts for 50 per cent of the methane emitted in a rice season.

Methane is 21 times more powerful as a greenhouse gas than carbon dioxide. So it seems this may be a beneficial side-effect of high pollution levels in countries such as China.

Lead researcher Vincent Gauci from the Open University said, 'We need to do further research, but it looks like there could be



a combination of processes at work. One line of investigation we'd like to confirm is that the sulfate component of acid rain may actually boost rice yields. Paradoxically, this might reduce a source of food for the methane-producing micro-organisms in the soil.'

Vincent added a note of caution. 'Acid rain is one of several pollution problems in Asia that need solving in the coming decades, but we need to appreciate the potential consequences of that clean up, one of which could be an increase in methane emissions.'

CALAMARI KILLING FIELDS

In the middle of a feeding frenzy, millions of squid-like creatures were stopped dead in their tracks, then perfectly preserved. Science writer Sara Coelho reports.



A VAST treasure trove of squid and fish fossils thought lost for 150 years has been uncovered at a site near the village of Christian Malford, Wiltshire.

The village was the location of an environmental catastrophe 165 million years ago during the reign of the dinosaurs. Somehow, the disaster exquisitely preserved millions of squid in what appears to be the middle of a feeding frenzy.

A further twist in the tale is that Victorian palaeontologists originally discovered the site in the 1840s during construction of the Great Western Railway connecting London to Bristol and the south-west. The find triggered a rush of collectors and heated scientific debate. But by the middle of the 1850s, the site flooded and was abandoned, its location forgotten beneath rubble and plants. Until now that is.

A team of scientists from the British Geological Survey and the University of Plymouth recently relocated the horde. The results are extraordinary.

Christian Malford was one of the first sites in the world

where scientists realised that rocks could preserve animal soft parts, as well as bones and teeth. Fins, ink sacs and arms with suckers and hooks are all on show.

Geologist Phil Wilby said, 'We found dozens of squid-like and other soft-bodied animals, rarely preserved in the fossil record.'

'Soft parts such as muscles and skin provide a clear view of ancient life. They allow animals that are millions of years old to be dissected as if they were still alive.'

165 million years ago Christian Malford lay beneath the Oxford Clay Sea, a wide and shallow sea.

But the sea here was blighted by ecological disaster. High densities of fish and squid fossils packed in different layers tell a tale of relentless catastrophe.

'The new excavation shows for the first time that environmental disasters repeatedly hit the area and killed vast numbers of the squid,' explained Phil. 'Algal blooms or anoxia (lack of oxygen) may have poisoned the surface waters.'

The dead bodies of thousands of marine animals were an irresistible bait for predators.

'Modern squid are voracious predators. They will take live and dead prey and they are not above eating their own species,' said Phil. 'It seems that the poisoned waters of Christian Malford worked as a predator trap. The carcasses attracted predators, which ended up as yet more victims of the poisoning catastrophe.'

Some of the squid died clutching fish and even other squid.

Soft-bodied squid-like cephalopods were widespread marine animals in the age of dinosaurs, but since they lack shells or bones, they can only turn to fossils in exceptional circumstances. With this new excavation, the British Geological Survey now owns a valuable collection of these animals.

A documentary on the Christian Malford deposit has been filmed by BBC Four as a part of the new *Fossil Detectives* series.

Preserving the unpreservable: a lost world rediscovered at Christian Malford. *Geology Today*, 2008.