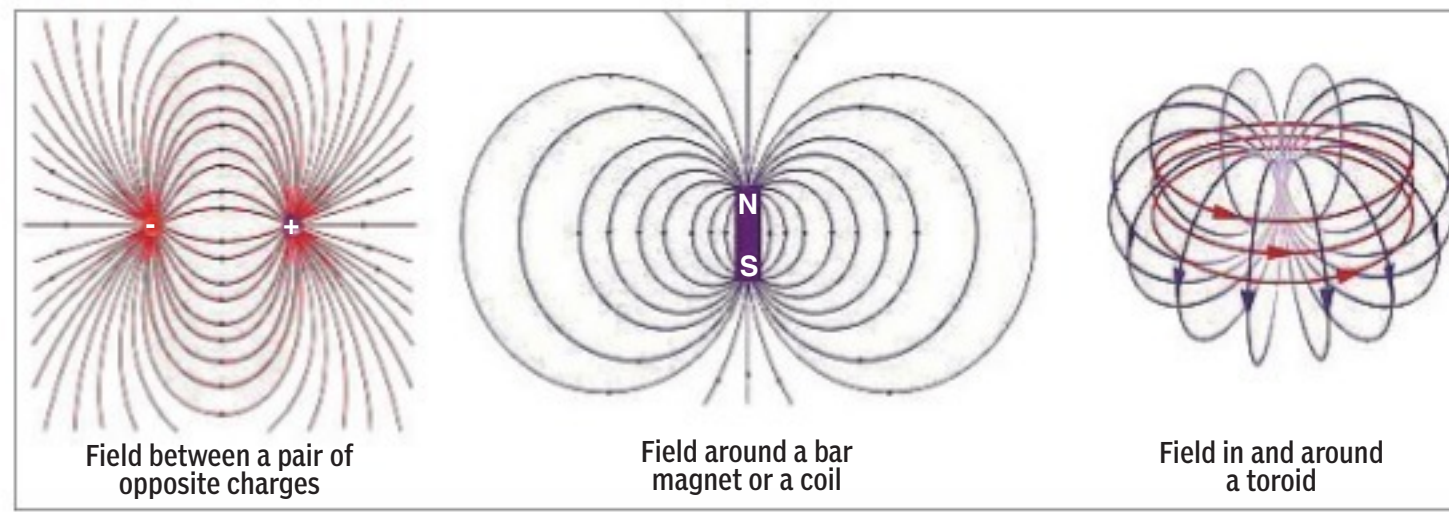


Energetic, but not radiating

ELECTRIC CHARGES WITH NO FIELD OR MAGNETS THAT HAVE NO POLES WOULD BE INVISIBLE, WRITES S ANANTHANARAYANAN



nucleus? However, it was known that the atom had a positively charged centre and the surrounding electrons had to be in motion for the atom to exist. And then there was the pattern in the energy of light that atoms emitted that could be explained neatly by proposing that there were special orbits.

What the international team writing in *Nature Communications* has done is to create a geometric arrangement of conductors and charges in such a way that the wave of energy generated by one part exactly cancelled out the wave generated by another part. Waves consist of alternating motion or the compression of particles or, in the case of e/m waves, of alternating electric and magnetic effects. If the stages of alternation of two waves, at a spot, are in opposition, like a rising ocean wave at the shore meeting a falling wave returning from the beach, the combined effect is that there is no motion, or no electric or magnetic effect.

Electromagnetic waves, like radio waves, or when the waves are very rapid, light waves, can be generated by up and down motion of charged particles, which happens in a radio station antenna, or when charges are moved in circles as in a coil. The nature of the waves generated becomes complex when the path of the charges assumes special shapes. One such is the *toroid*, or doughnut shape of a long hollow, coiled spring that is itself wrapped round in a ring. Electric charges flowing through such a path would have one motion along the coils of the spring and also motion in the circle of the ring. A straight coil creates a field like a bar magnet. A toroid would then create a field in a circle and the arrangement would show a field along the axis of the toroid called the electric dipole, and also due to the movement in circle along the toroid called the toroid dipole. It is possible to consider dimensions of the arrangement where two alternating effects at a distance consist of

waves that are in opposition and hence cancel out. The arrangement would be an instance of an *anapole*, or an assembly "without a pole".

In general, such an arrangement that represents a state that takes energy to set up but has no external field is not feasible as it violates the principles of symmetry. In working out the principles of these arrangements, the authors of the paper found that an alternate way of working out the fields showed that there were dimensions at which the toroid dipole effect became important and could almost cancel the electric dipole field. "We realised that these toroidal components were not just a correction but could be a very significant factor," says Dr Miroshnichenko of the Australian National University. The implication is that the anapole at these dimensions should not scatter incident light and become invisible!

As for the question of whether it was possible to experimentally observe the anapole mode, the team worked it out that a silicon nanodisk measuring 50 nanometers high with a diameter of 200-400 nm would satisfy the requirements. They hence grew silicon crystals of 160-310 nm on a quartz substrate and carried out a series of experiments on scattering of light. It was found that for a diameter more than 200 nm, there was a dip in the intensity of scattering about the wavelength 550 nm (green-yellow), moving to the red side and becoming more pronounced as the diameter of the disk was increased.

The effect is essentially one of radiation exciting two different and interfering dipoles in the anapole. Radiationless current configurations could be investigated as underlying the stable orbits of electrons in atoms. The same idea also supports a model that has been proposed to account for "dark matter", a form of non-radiating and non-scattering matter that constitutes 85 per cent of the mass of the universe.

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PLUS POINTS

Pluto's alien life

According to physicist Brian Cox, Pluto's surface is made up of a crust that includes huge icy mountains that is very unlikely to have anything living on it, but underneath that could be warm oceans that might be able to support life. The *New Horizons* probe flew past the dwarf planet last month, snapping photos and other readings as it went. It has sent back some of those photos showing Pluto in more detail than ever before and will continue to do so in the coming weeks.



The three billion-mile journey to Pluto began nine and a half years ago.

Cox said the information sent back had already given hope that the planet might be able to support life. The probe "showed you that there

may well be a subsurface ocean on Pluto, which means — if our understanding of life on earth is even slightly correct — that you could have living things there," Cox told *The Times*.

There's still much more to do to fully understand the planet. Scientists have only seen five per cent of the information taken by the probe and it will start sending back more information from next weekend. That will tell us much more about Pluto, adding to our already hugely-improved understanding of it. But it probably won't be able to tell us whether there's warm water there — instead, the best bet is looking on similar planets that are nearer.

Cox, however, warned against getting too excited about finding other living things in our own galaxy. "What science is telling us now is that complex life is probably rare," he said. "We're physically insignificant and yet probably very valuable."

ANDREW GRIFFIN/THE INDEPENDENT

Drugged environment

In the fall of 2012, PhD student Hendrik Wolschke leaned over the side of a boat on the Elbe river in northern Germany, lifted



a stainless steel bucket from the water's depths and set it next to a pile of empty plastic bottles. Once he'd filled these with river

water, he packed the bottles into coolers for transport southeast to the chemistry laboratory of his doctoral advisor, Klaus Kümmerer, at Leuphana University.

Each sample was tested for the most widely prescribed anti-diabetic drug in the world — *metformin*, which treats high blood sugar by suppressing the liver's glucose production. Humans do not metabolise the drug, so within 24 hours of being swallowed, metformin is excreted from the body essentially unchanged. Because of its high prescription rate — the USA alone dispensed 76.9 million metformin prescriptions in 2014 — it's not surprising that the drug is abundant in the environment.

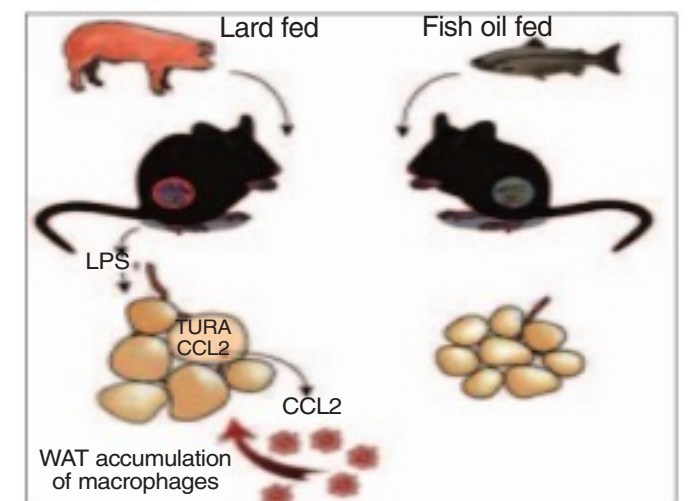
Metformin was present in every water sample Kümmerer's team tested, including tap water, at concentrations exceeding environmental safety levels proposed by an international Rhine river basin agency by 50 per cent. They concluded that the drug was likely "distributed over a large fraction of the world's potable water sources and oceans".

The conclusion? That people have spiked ecosystems with a flood of active pharmaceuticals that are feminising male fish, confusing birds and worrying scientists.

MEGAN SCUDELLARI/THE SCIENTIST

Influence of fats

The types of lipids mice consume affect the composition of their gut microbiota, which influences whether the animals develop obesity-related inflammation, according to a study published on 27 August in *Cell Metabolism*. In research carried out by a team of investigators at the University of Gothenburg in Sweden,

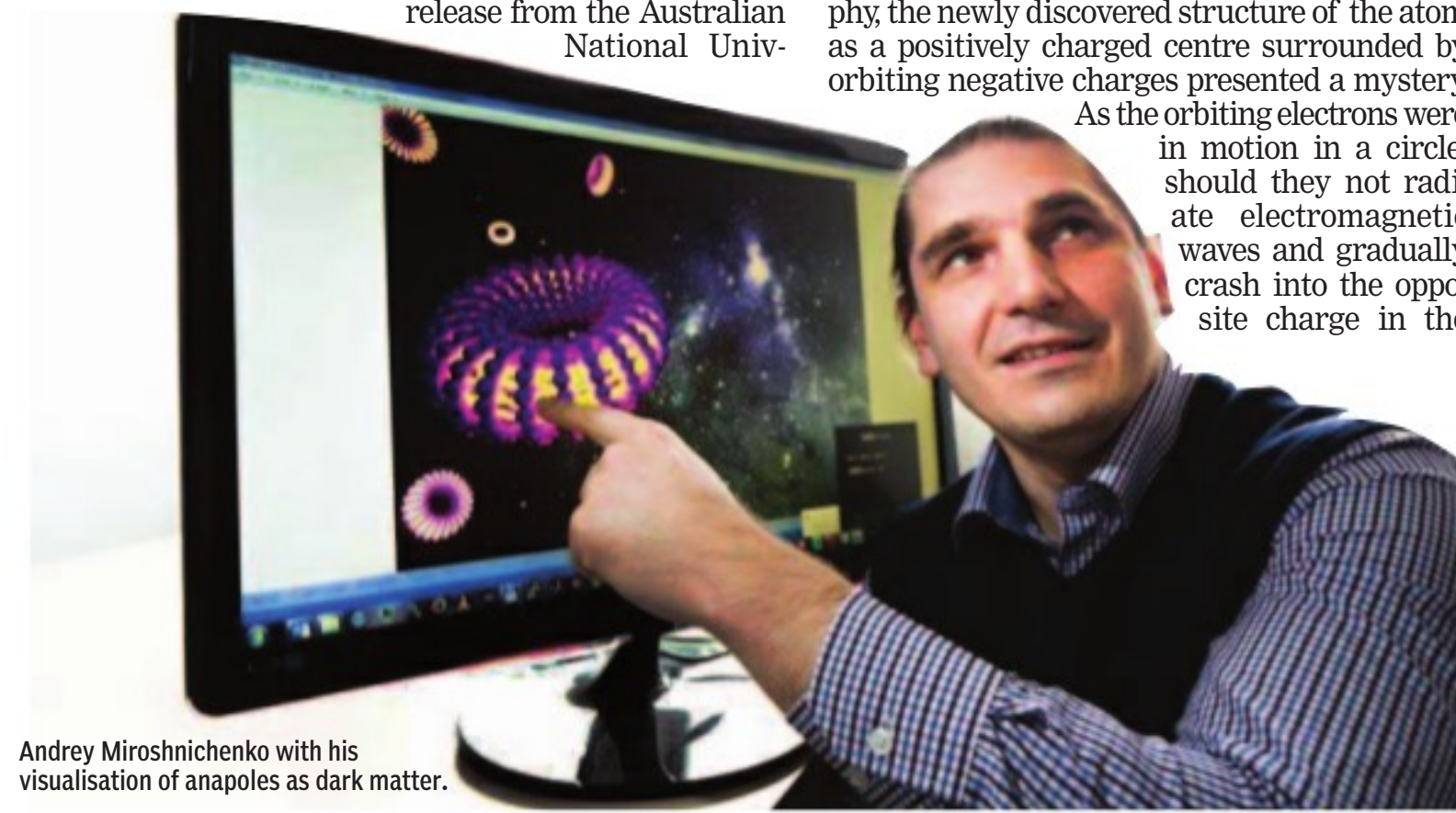


mice fed a high-lard diet for 11 weeks developed signs of metabolic disease, while mice fed fish oil remained healthy. When the researchers transplanted gut microbes from fish oil-fed mice to antibiotic-treated mice and then subsequently fed the animals lard, the mice were protected from the typical unhealthy effects of the saturated fat. "This paper, which had nicely controlled conditions, demonstrated that the type of fat is really important for shaping microbial communities and their functional dynamics, which in turn impact our health," said Vanessa Leone, a post-doc studying host-microbe interactions at the University of Chicago.

KATE YANDELL/THE SCIENTIST

It is well known that electric charges that are speeded up or slowed down would radiate electric and magnetic waves. But there are still electrically charged electrons going round in atoms and they never lose energy and slow down. The quantum theory has it that electrons have special orbits where they do not radiate and jump from one orbit to another, in steps of energy, when they absorb or give out a packet of energy in the form of a photon, or a particle of light. But why there should be such favoured orbits has not been clearly answered.

An international team comprising Andrey E Miroshnichenko, Andrey B Evlyukhin, Ye Feng Yu, Reuben M Bakker, Arkadi Chipouline, Arseniy I Kuznetsov, Boris Luk'yanchuk, Boris N Chichkov and Yuri S Kivshar from the Acton in Australia, Hannover, Moscow, Singapore, Darmstadt near Frankfurt and St Petersburg report in the journal *Nature Communications* that they have succeeded in creating an arrangement that contains electrical energy but shows no radiation at a distance. Such an arrangement would throw light (sic) on the nature of atoms and even the nature of dark matter, which has been found to dominate the universe but does not interact except in the form of gravity, according to a release from the Australian National Univ-



Andrey Miroshnichenko with his visualisation of anapoles as dark matter.

INHIBITING INFECTIONS

ANTIVIRUS IMMUNITY IS MANIFESTED AT EVERY LEVEL OF AN ORGANISM BY DIFFERENT PROCESSES, WRITES TAPAN KUMAR MAITRA

Immunity against virus infections is manifested at all levels. At the molecular level, specific immunoglobulins react with the molecular groups of the virus receptors and also non-specific humoral factors, inhibitors and interferon. At the cellular level, phagocytosis and other defence reactions of the cells and tissues occur. In the whole organism, resistance is manifested by excretory functions, rise in body temperature, acidosis, hypoxia, et al.

In an acute virus infection marked by a cytopathic effect, antibodies cause a defence effect but have no bearing on the development of a latent infection caused by the same virus. A neutral virus-antibody complex may be reactivated by dilution, change of pH, or from a super-neutralised complex by a freon. Defence reactions against viruses that have penetrated the cells are accomplished by means of interferon and other antiviral inhibitors. Humoral factors (specific immunoglobulins and non-specific inhibitors) prevent access of the virus to the sensitive cell. Antibodies may render the virus harmless by adsorption on the cell surface and make sure it does not penetrate the infected cell and, if at all, in negligible amounts.

The formation of intracellular inclusions in virus infections is also considered to be a defence reaction of cells. Antiviral resistance may be revealed as a result of interference (mutual weakening) of viruses. The mechanism depends not on antibodies but on the ability of one virus to neutralise the action of another by blocking sensitive cells. Though the principle of interference has not been revealed, it has been suggested that among interfering viruses there is a competition for substrates in the host cells that they utilise for their activities.

Interference takes place among definite strains of the same species of virus. Thus, for example, the vaccine strains against rabies, influenza and yellow fever have interfering properties relative to the causative agents of these diseases. The phenomenon of interference between viruses affecting plants, animals and humans has been established. This incompatibility was revealed between viruses of rabies and foot-and-mouth disease, viruses of rabies, vaccinia and herpes, between viruses of poliomyelitis and lymphocytic choriomeningitis.

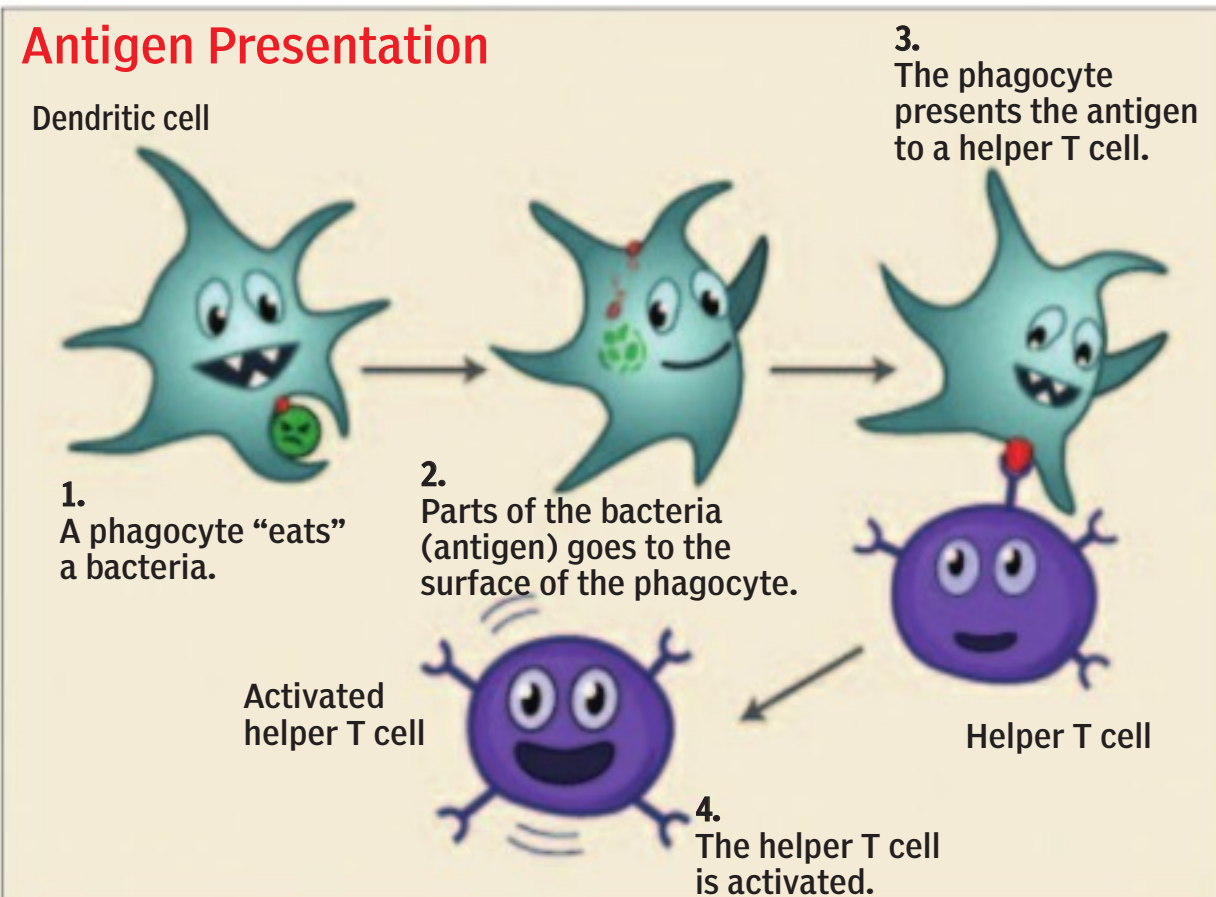
Under the influence of the virus, some cells become resistant to repeated infection by the same virus. It has been noticed that in a nutrient medium of a tissue culture a substance appears to be capable of neutralising the virus but this kind of immunity does not have a strictly marked specificity. In a viral disease following a common course, cells may produce interferon, a protein, in an amount that may arrest the infection process. A virus that enters the cell removes the repressor, which delays the synthesis of interferon. It does not act directly on either the virus or its nucleic acid and does not hinder adsorption of the virus and its entry into the sensitive cell; it does not inhibit de-proteinisation of the virus

nucleic acid and the synthesis of late structural virus proteins and does not affect the assemblage of virions and their release from the cells.

But interferon de-represses the gene contained in chromosome 21, which is responsible for the synthesis of antiviral protein. Entering new cells, interferon stimulates the production of a new protein or polypeptide that inhibits the reproduction of viruses. It disturbs the process of translation of the virus information, suppresses the formation of polysomes consisting of virus messenger RNA and cell ribosomes.

The pyrogenic effect of factors capable of inducing fever should be regarded as the most important defence mechanism. In the absence of virus-sensitive cells, the causative agents that entered the organism perish.

Non-specific cellular resistance linked with the excretory functions of the body is also extremely important. It has been established in a number of diseases that viruses may be excreted through the upper respiratory passages, the intestine and the kidneys. In intensified secretory-excretory activity, as



the result of which antibodies and inhibitors exert their effect on the viruses more easily, protective membranes form around the aggregates of virions and isolate them from the cell cytoplasm; this type of virion blocking occurs in the epithelial cells and bronchi in influenza.

One millilitre of a healthy person's blood contains about five mcg of nucleases. At least 50 mcg per ml of such are required to destroy the virions with membranes as against three mcg/ml for those without them. High-tension artificial immunity is reproduced for some diseases (smallpox, rabies, yellow fever, poliomyelitis, epidemic parotitis and measles). Intensive research is being conducted to obtain vaccines against influenza and other virus infections. A great advancement is the production of gamma globulins used in the treatment and prevention of smallpox, rabies, virus hepatitis, influenza and other viral diseases.

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Britain's very own Atlantis

SCIENTIFIC STUDY BENEATH THE NORTH SEA IS ALL SET TO UNEARTH EVIDENCE SUBMERGED BY RISING OCEANS, SAYS DAVID KEYS

In a unique and groundbreaking operation, scientists plan to search for evidence of Stone Age human activity on Britain's very own "Atlantis" — a vast prehistoric land once located between England and southern Scandinavia that was engulfed by rising sea levels some 7,500 years ago.

They hope to find evidence of flint tool manufacture, plant pollen and the DNA of plant and animal species used by the long-lost land's ancient inhabitants. Due to be launched later this month, the multi-million pound project is the largest of its kind ever attempted anywhere in the world and will lead to the development of an entire range of new scientific techniques and capabilities.

Past survey work in the southern part of the North Sea has identified some of the vanished territory's original river valleys — and it is two of those now-long-drowned valleys that the scientists will target in their search. They plan to recover ancient pollen, insects and plant and animal DNA and to use high-definition survey techniques to accurately rediscover what the lost Stone Age landscape looked like, what vegetation flourished there and how humans impacted on and used the environment.

The project will reveal, for the very first time, the culture and lifestyle of the dozens of generations of prehistoric Brits who flourished there for 6,000 years until it finally disappeared beneath the waves in the mid-sixth millennium BC.

This real British Atlantis originally covered some 100,000 square miles of what is now the North Sea (a long-lost territory around the size of modern Britain). However, following the end of the Ice Age, thousands of cubic miles of sub-Arctic ice started to melt and sea levels began to rise worldwide. The major period of ice melt and consequent sea level rise, that specifically affected the southern part of the North Sea region, occurred between 8000-6000 BC.

During that period of sea level rise, what were then coastal zones became increasingly vulnerable to catastrophic flooding. It is likely that massive storm surges — some up to 15 feet high — would have devastated large areas, probably on average around four times a century. Due to the concentration of human hunter-gatherer activity in food-rich coastal and estuarine areas, such surges would have almost certainly drowned hundreds of people each time.

Gradually, most of the 100,000 square miles became permanently inundated — and by 6500 BC, the remnants of the dwindling North Sea territory had become a 140-mile long, approximately 100-mile wide island covering thousands of square miles (partly where the North Sea's Dogger Bank is today). But over the centuries, it gradually shrank and was finally overwhelmed by the waves in around 5500 BC. It is conceivable that at least



An artist's impression of tribes fishing during the Mesolithic period. The new study aims to reveal the culture and lifestyle of prehistoric humans.

some of its last inhabitants would not have been able to escape.

Now, almost eight millennia after the death of Britain's North Sea Atlantis, archaeologists are about to rediscover its secrets. It is hoped that their research will reveal where the inhabitants lived, what they ate and what their environment looked like.

The expedition also hopes to discover whether they were culturally more advanced than previously believed. Plant DNA, recently obtained from another "drowned" landscape (the Solent, between the Isle of Wight and mainland England) suggests that Stone Age people in that area were eating (and therefore importing or possibly growing) wheat some 2,000 years earlier than previously thought.

Now the scientists plan to systematically search for similar wheat or other domesticated species' DNA evidence in what was once dry land under the North Sea. Within the next few weeks they will start sinking bore holes into the drowned Stone Age land surfaces in order to extract samples of ancient earth. Hundreds of such samples will be taken to the laboratories at the Universities of Bradford, Warwick, Lampeter, St Andrews and Birmingham where scientists will separate out seeds, pollen, potential DNA material and tiny fragments of broken flint (the tale-tale evidence of flint tool manufacture).

Using sonar and high definition seismic equipment, the archaeologists will also produce more refined 3D maps of the original landscape and its topography. It's conceivable that they may even locate man-made Stone Age structures, potentially the remains of any timbers used for ritual monuments or hunting driveways.

The research is likely to transform the academic world's understanding of pre-agricultural British society. That is because the vast majority of pre-agricultural Britons almost certainly lived in now-long-drowned coastal environments — and very few such areas have ever been systematically investigated. The project may also revolutionise the world's understanding of the spread of agriculture.

THE INDEPENDENT