As scientific techniques become ever more sophisticated, the field of archaeology is changing our understanding of how the environment has changed and been changed by our interaction with it. The availability of new analytical processes has shone light on archaeological mysteries and allowed researchers to better understand how our cultural and geographical heritage has been shaped by those who have gone before us.

**SITE SURVEYING**

The first step in identifying a potential archaeological site is to do a site survey. There are many different ways to do this: through maps, historical documents, field walking, measuring resistivity, magnetometry, metal detection and sample excavations. Any of these methods can be used, and often several are used to understand where to excavate, as excavation is neither time nor cost effective. By looking for unusual aspects in the topography – best seen using aerial photography – it is possible to see which areas are most likely to contain settlement remains. Furthermore, unusual or thick vegetation can suggest a particularly rich soil substrate with animal or plant remains, indicating a good site to excavate, but can equally suggest the soil has been more disturbed in that area.

**STRATIGRAPHY**

Soil and other matter such as human debris are deposited in layers that are called 'strata'. These layers are normally only visible during excavations, and can easily be identified visually or during analysis, as strata often look different and each stratum is characterised by individual chemical and elemental compositions. This identification gives an understanding of the chronology of the study site.

In general, the further down you dig, the older the strata and objects are likely to be. If there are datable objects in a particular stratum, it is generally inferred that that stratum and all the objects in it are likely to be of a similar age. This is not always the case, as ploughing can disturb the object chronology closer to the surface. Therefore when a site has been developed, the usable chronological sequence typically available from soil strata is rendered useless.

**TREE-RING DATING**

Tree-ring dating (dendrochronology) is a method by which the age of a tree or a piece of wood can be established by its rings. Tree rings vary in thickness due either to the increasing age of the tree or the weather during the tree’s lifetime. For example, in a year with more rain than normal, a tree ring will be especially wide. The varying weather over a number of years therefore leads to a particular pattern of wide and narrow rings in all the trees in a particular area. This enables tree-rings in different trees to be compared, creating a distinctive chronology of the tree rings. Therefore, any trees, as well as and logs or beams from houses, can be dated by matching their tree-ring pattern to the chronology.

Tree ring data also provide a greater understanding of the historic weather conditions in the area where the tree grew.

Maddy Riley describes some common techniques used in archaeology, and how they help to decode the information provided by the environment.
ANALYSIS

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BONE CHEMICAL ANALYSIS
By calculating the nitrogen, fluorine and uranium content in bones, their approximate age can be established. The amount of nitrogen in the protein content of bones decreases over time – a live bone contains approximately four per cent nitrogen. The speed of the decrease in the nitrogen content depends on the surrounding soil conditions (such as acidity and temperature). These properties also affect fluorine and uranium content, as buried bones absorb fluorine and uranium over time. This technique can only ever give a very approximate age as it is so dependent on soil content and status. Therefore it is only used for relative dating, such as for the comparison of bones on the same site to establish their ages relative to each other.

RADIOACTIVE CARBON DATING
Radioactive dating is a process that enables the approximate age of organic materials (such as wood, leather or bone) to be identified using measurements of its carbon isotopes. Isotopes are different forms of the same element, and the difference lies in the number of particles called neutrons in the nucleus. Carbon has three common isotopes that exist in known proportions to each other: carbon-12, carbon-13 and carbon-14; the first two are stable, but carbon-14 is radioactive and therefore decays at a known rate (its half-life). Once an organism dies, its regular carbon intake stops, and the amount of carbon-14 starts to decrease. The proportion of carbon-14 left in an organic material is measured, and from this its age is calculated. Carbon dating can give the age of organic materials up to about 60,000 years old.

RADIOACTIVE CARBON DATING

3D SCANNING
Photographing surfaces to create 3D detailed images of objects and sites allows the study of the minute details undetectable to the human eye. Sophisticated computing software allows detailed analysis of particular features of objects or sites. For example, using different lighting techniques and angles on ancient texts can allow the detection of writing that is invisible to the naked eye, including that which has been erased or lost because of weathering to the material. Scanning Electron Microscopy (SEM) allows much higher levels of magnification than traditional microscopy and is used for high resolution study of the surface of artefacts.

ISOTOPIC ANALYSIS
Isotopic analysis is used to determine the precise proportion of different elements and their isotopes in an object. This is done because organisms from different geographic areas are made up of slightly different proportions of elements. Therefore, depending on the accuracy and precision of the instruments used for measurement, it is sometimes possible to provenance a material. By knowing the type and provenance of a material, it is possible to begin to understand the journey it has gone through, for example whether it is found near its origin, or whether it has been carried a long way. This can provide useful information on the movements of populations and occasionally provide insight into the relative cultural importance of different materials.

BONE CHEMICAL ANALYSIS
By calculating the nitrogen, fluorine and uranium content in bones, their approximate age can be established. The amount of nitrogen in the protein content of bones decreases over time – a live bone contains approximately four per cent nitrogen. The speed of the decrease in the nitrogen content depends on the surrounding soil conditions (such as acidity and temperature). These properties also affect fluorine and uranium content, as buried bones absorb fluorine and uranium over time. This technique can only ever give a very approximate age as it is so dependent on soil content and status. Therefore it is only used for relative dating, such as for the comparison of bones on the same site to establish their ages relative to each other.
STONEHENGE: ENVIRONMENTAL TECHNIQUES IN PRACTICE
Stonehenge is one of the most iconic archaeological sites in the world and its purpose remains a hotly disputed mystery. It is therefore a perfect example of how newer techniques have shone light on different aspects of its history.

SITE SURVEYING
Site surveying Stonehenge is useful for visualising the site as a whole. Whilst Stonehenge was originally considered a solitary monument, by analysing its location – close to the River Avon and therefore easily accessible – and its position with respect to other sites, it has been suggested that Stonehenge is strongly linked to other sites nearby. Its proximity to the Avon means that it would be possible for people to travel to the site from greater distances and reinforces the isotopic evidence demonstrating the range of geographic origin discovered amongst the remains onsite.

For example, the nearby Durrington walls site was inhabited for around 35 years, and in this time housed approximately 4,000 people. It is possible, because of its proximity to Stonehenge, that these inhabitants were the builders of Stonehenge.

PHOTOGRAPHIC 3D RECORDS
Photographic imaging has allowed the stones to be explored from different angles and in different lighting. By modifying the images it is easier to identify unusual features and understand more about the stoneworking techniques used in their extraction and modification. For example, laser scanning led to the discovery of rock art and carvings on the stones.

The types of grooves left from working the stone give hints as to what type of tool may have been used, and how. From the imaging it seems likely that hammerstones were prominent in the shaping and polishing of the stones.

CARBON DATING
Antlers are known to have been used elsewhere as digging tools, and those found at Stonehenge were likely used for this purpose as well. Carbon dating shows that the antlers found on site vary in age. However, this does not mean that they were used at different times, simply that the deer died or shed their antlers at different times.

ISOTOPIC ANALYSIS
Isotope analysis has been used to determine the provenance of the domestic animal remains on site at Stonehenge as it can be carried out on tooth enamel using isotopes of oxygen, strontium and sulphur.

The isotopic analysis of animal remains at Stonehenge provided an additional level of mystery, as many of the...
animals came from as far as Scotland. With isotopic evidence demonstrating mass-gatherings of people from across the British Isles, the theory evolved to suggest that the site held a religious significance, meaning that people flocked to Stonehenge for the summer and winter solstices. Given the age and provenance of the various animal remains it is likely that the animals were brought with groups of people visiting the site rather than as a result of regular trade at Stonehenge itself.

Analysis of sulphur isotopes was also used to disprove a prevailing theory about a nearby population called the Beaker people. Originally it was proposed that this population had travelled across Europe to reach Britain. However, sulphur isotope analysis showed that around half of the bodies analysed proved to be from people who grew up near Stonehenge, and very few who may have grown up outside Britain.

**Maddy Riley** is a student at the Institute of Archaeology, University College London, studying Archaeology. She aims to specialize further in the scientific aspects of archaeological discovery.