Forensic science

Tracing stolen stones

Anthony King

A UK heritage crime survey by Loughborough University's social sciences department indicates that stone is now the third most popular target for thieves at heritage sites, behind copper and lead. Thieves are stealing headstones, pavements and sculptures from churches, monuments and villages.

Now, a novel forensics technique developed by Loughborough researchers promises to help catch them out by analysing the surface composition of the stone in order to trace its origins.

'We find quite significant variation from different sites,' says inorganic chemist Paul Kelly at Loughborough. 'We believe this allows us to take off the surface effects and that this must be a function of the environment in which the stone has been sitting. If it's been in the middle of a city, then we will discover pollution effects and characteristics very different from that of a surface sitting in a countryside churchyard for the last 200 years.'

His team is now investigating the reliability of the method for provenancing stone. 'We need to prove that it is meaningful and reproducible,' says Kelly.

The technique relies on employing a laser to smash residues down to their elemental composition and then recording the spectral signatures of the resulting atoms. A gelatine film, as used in DNA fingerprinting, is used to lift the surface residue from stone under investigation. The group previously used a gelatine film to create a map of metal traces from the hands of someone suspected of metal theft (*RSC Advances*, doi: 10.1039/c4ra02463j).

'[Historic stone theft] is a growing area of crime which requires robust and relatable tools. The described method has two main advantages: it is non-destructive and requires a very small sample for analysis,' comments Lorna Dawson, forensic soil scientist at the James Hutton Institute in Aberdeen, Scotland. However, 'tracing the resultant elemental profile to possible places of origin would require an extensive parallel database to be created.'

Elizabeth Stevens / EyeEm/Getty

If recovered stones can be compared with those in specific areas, especially if the stone is of national historic and archaeological value, then this technique can be particularly useful for confirming or refuting their origin, she says.

Further validation studies would need to be carried out with 'actual case samples,' and to 'establish that it is robust enough to withstand court scrutiny,' says Dawson. Parallel approaches include the use of microbial profiles, elemental dissolution analysis and isotope analysis of the rock surface, she adds.

Antibiotic resistance

Chestnut disarms superbug

Kathryn Roberts

US researchers have shown that an extract from the leaves of the European chestnut tree can disarm the superbug MRSA (methicillin-resistant *Staphylococcus aureus*), without generating further bacterial resistance (*PLOS one*, doi: 10.1371/journal.pone.0136486). Rather than killing the bacteria, the extract inhibits the organism's ability to produce disease-causing toxins.

Infections caused by *S.aureus* often start in open wounds in skin or through the nasal passage, and progress via a cascade of toxins – enzymes, red cell-busting hemolysins and toxins such as delta toxin. The expression of this communication system – known as 'quorum sensing' – is controlled by the release of 'auto-inducing peptide' (AIP) through the accessory gene regulator (Agr) system.

Researchers Cassandra Quave at Emory University in Atlanta, Georgia, and Alexander Horswill at the University of Iowa, hypothesised that chestnut leaves contained Agr inhibitors. The research was inspired by an earlier investigation by Quave into botanical folk medicines used in southern Italy to treat skin infections, which screened over 100 plants. The results highlighted an extract from European chestnut, which inhibited quorum sensing in *S. aureus* but not bacterial growth. Teaming up with Agr researcher Horswill, Quave set about unravelling the chemical secrets of the extract.

The collaboration revealed 94 actives, predominantly derivatives of the pentacyclic triterpenes ursene and oleanene. Quave comments: 'Based on structural studies in other labs, we know there are four different types of AIPs corresponding to four Agr types, so we are now looking to find out if one compound can block all four or if a mixture of compounds is needed.' The question, she says, is whether it will be more beneficial to have a multicomponent or a single drug therapy. 'My guess is we will be looking to use any future drugs identified in combination therapy with antibiotics to improve antibiotic efficacy and patient recovery by eliminating the toxins that really do a lot of damage to the host tissue.'

Cytotoxicity studies found the extract doesn't disturb the healthy bacteria typically found on human skin, so other potential applications could be as skin creams for eczema, or surface treatments to prevent MRSA transmission.

John Mann, emeritus professor of chemistry at Queen's University, Belfast, UK, comments: 'This comprehensive study is part of the current interest in selective inhibition of bacterial communication mechanisms. The results are promising, but it will be a long haul to identify which substances in the isolates have the requisite antibacterial activities.'