Study Pits Man v Machine in Piecing Together 425-Million Years Old Jigsaw

November 16 2009

The palaeontologists' puzzle - each of these conodont teeth is less than a millimetre long. Working out how the different shapes fitted together, and which were parts of the same skeleton is a complex problem.

(PhysOrg.com) -- A new study pitting academic expertise against a computer in recreating a 425 million-year old jigsaw puzzle has discovered that there is no substitute for wisdom born out of experience.

The research tested the reliability of expert identification versus computer analysis in reconstructing fossils. The investigation, based on fossil teeth from extinct vertebrates, found that the most specialized experts provided the most reliable identifications.

University of Leicester researcher Dr Mark Purnell said: "Being a palaeontologist can be fun, but sometimes it isn't easy. Take vertebrates,

the group to which we belong. When a vertebrate animal dies, whether it's a fish, a sabre-tooth cat or a dinosaur, the flesh rots away and the bones of the skeleton are usually scattered before being fossilised. In order to interpret them correctly, the palaeontologist must piece them back together, or at least work out which bits are which.

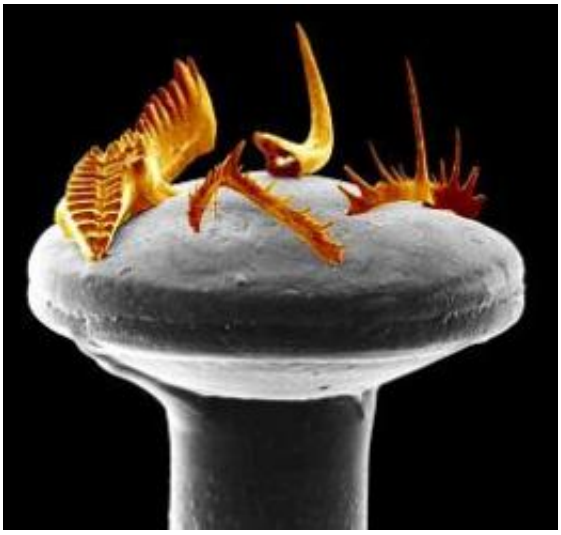
"This is difficult enough when you have modern relatives for comparison; but what if there's nothing alive today that's remotely like the extinct animal you need to analyse? It's exactly like doing a jigsaw puzzle without a picture."

This is what faces palaeontologists who study conodonts. Lead author David Jones, who carried out the study while at the University of Leicester, explains: "Earth's oceans teemed with conodonts for 300 million years; they were the most common vertebrates around, and they were the first to evolve teeth. In fact the conodont skeleton was all teeth: a basket of hacksaw-shaped blades which was extended out of the mouth to grab prey, behind which lay pairs of slicing blades and crushing teeth - a set of gnashers straight out of Alien."

Ancient marine rocks are often packed with hundreds or thousands of scattered conodont teeth, with many species jumbled up together.

"To make matters worse, within any one animal, teeth from different parts of the skeleton looked almost identical! Now we have a jigsaw puzzle with no picture, where each piece could go in different places. But just so it's not too easy, conodont teeth are also microscopic, "said Dr Purnell, of the Department of Geology.

Traditionally, experts would wrestle with this puzzle based on their previous experience and comparison with more complete skeletons, but researchers investigated whether there is another way?



Four different types of conodont teeth from different species- pieces from different puzzles - mounted on a pinhead.

For the new study, published in the latest issue of the journal *Palaeontology*, David Jones and Mark Purnell, from the University of Leicester, teamed-up with Peter von Bitter from the Royal Ontario Museum, Canada, to bring sophisticated statistical techniques to bear on solving this skeletal jigsaw. They used material from a 425 million year old rock deposit in Ontario, Canada which, unlike almost all other deposits in the world, preserves both scattered teeth and complete skeletons of conodonts. This material allowed them to compare the success rate of experts in placing the teeth in the correct positions within the skeleton, with the success rate of computer-based methods.

So how do the experts stack up against the machines? “Pretty well” says Jones. “This is reassuring for palaeontologists! but the computer-based approach did at least as well and was also consistent; experts disagreed amongst themselves, and less experienced palaeontologists, not surprisingly, made more mistakes.

“The statistical techniques therefore allow us to test and verify the conclusions drawn by palaeontologists, greatly increasing the confidence with which we can reconstruct the skeletons of extinct vertebrates. But it’s not time to retire the experts; at least not yet...” say the researchers.

More information: The paper, “Morphological criteria for recognising homology in isolated skeletal elements: comparison of traditional and morphometric approaches in conodonts” by David Jones, Mark Purnell and Peter von Bitter is published in the current issue of *Palaeontology*.

Provided by University of Leicester (news : web)