

Dinosaurs and the secrets they still hold

Dinosaur expert Dr Steve Brusatte continues to investigate the mysteries surrounding these fascinating prehistoric creatures

I was recently part of a team of palaeontologists that discovered a new dinosaur. Living in what is now China, the species would have resembled a strange bird. It was about the size of a sheep and covered in feathers, with a sharp beak that it probably used to crack open shellfish. It was given the formal scientific name *Tongtianlong*, but we called it 'Mud Dragon' because its skeleton was discovered in rock that had hardened from ancient mud. It seems that the creature got trapped in the mud and died. Then its fossil remains were found a few months ago when workmen were excavating a site in order to build a school.

It is every dinosaur-obsessed child's dearest wish to discover and name a completely new species. In fact what my colleagues and I did wasn't that unusual. New dinosaurs are appearing everywhere these days – about 50 each year. And this pace shows no signs of slowing, as different areas continue to open up to fossil hunters and a fresh generation of scientists comes of age. Because of this plentiful supply of new fossils, we now know more about dinosaurs than we do about many modern animals. But there are still many unsolved mysteries.

Dinosaurs didn't start out as huge monsters like *Tyrannosaurus Rex*. Instead they evolved from a group of angular, cat-sized reptiles called *dinosauromorphs*. These creatures remained small and rare for millions of years until they developed into dinosaurs. The boundary between *dinosauromorphs* and dinosaurs is becoming less and less distinct with each new discovery that's made, but what's becoming

clear is that it took millions of years for these first dinosaurs to spread around the world, grow to huge sizes and become truly dominant.

Some discoveries in the 1970s, like the agile and strangely bird-like *Deinonychus*, proved that dinosaurs were far more dynamic and intelligent than previously thought. Some palaeontologists even proposed that they were warm-blooded creatures like modern birds with a constant high body temperature that they controlled internally, rather than from warming themselves by lying in the sun. A few decades later opinions are still mixed. The problem is that dinosaurs can't be observed. Palaeontologists must rely on studying fossils. Some results are convincing: we know from studying their bones that dinosaurs had rapid growth rates, just like modern, warm-blooded animals. Other palaeontologists, however, use the same fossils to suggest that dinosaurs were somewhere between cold-blooded reptiles and warm-blooded birds. More studies are needed to provide more clarity.

The discovery of *Deinonychus* with its long arms, skinny legs, arched neck and big claws on its feet, helped to strengthen the theory that birds evolved from dinosaurs. In the late 1990s, the discovery of thousands of feather-covered dinosaurs closed the argument.

But the fossils raised another question: why did feathers first develop in dinosaurs? They probably originated as simple, hair-like strands — a necessary means of keeping warm. Many dinosaurs retained this basic fluffy coat, but in one group the strands modified. They grew bigger, started to branch out and changed into feathers like those on modern birds. They lined the arms, and sometimes the legs, forming wings. These feathers were probably for display: to attract mates or

scare off rivals. They appeared in species such as the ostrich-like Ornithomimosaur. Such creatures were too large to fly. Flight may actually have come about by accident when smaller winged dinosaurs began jumping between trees or leaping in the air, and suddenly found that their wings had aerodynamic properties. This is one of the most stimulating new notions about dinosaurs and a fascinating area for further investigation.

There's something else that these feathers can tell us. They allow us to determine what colour dinosaurs were. If you look at modern bird feathers under a microscope, you can see tiny blobs called melanosomes. These structures contain melanin, one of the main colour-producing pigments in animals. Some are round, others are egg-shaped, etc. And that's important, because different shapes contain different colour pigments. So if you can identify the shape, you can identify the colour. A few years ago, some palaeontologists realised that you could find melanosomes in particularly well-preserved fossil feathers. They discovered that different dinosaurs had different melanosomes, which meant they had a variety of colours. Dinosaurs, therefore, probably came in a rainbow of colours – yet another thing that links them to modern birds.

The most enduring mystery of all, which has been argued about ever since the first dinosaur fossils were found, is 'Why aren't dinosaurs around today?' Of course, we now know that birds evolved from dinosaurs, so some dinosaurs do continue in a sense. But there's nothing like a Tyrannosaurus Rex today. They dominated the planet for over 150 million years, but suddenly disappeared from the fossil record 66 million years ago. That's when a 10 km-wide asteroid came out of space and struck what is now Mexico, impacting with huge

force and unleashing earthquakes, tidal waves, wildfires and hurricane-force winds. Although palaeontologists still like to argue about what part the asteroid played in the dinosaurs' extinction, there really isn't much of a mystery left. The asteroid did it and did it quickly. There are few signs that dinosaurs were struggling before the impact. None survived except a few birds and some small furry mammals. They found themselves in an empty world, and as the planet started to recover, they evolved into new creatures, including the first apes, and so the long journey began to the beginning of humankind.

Questions 11-13

Look at the following statements (Questions 11-13) and the list of prehistoric animals below.

Match each statement with the correct animal, A, B, C or D.

Write the correct letter, A, B, C or D, in boxes 11-13 on your answer sheet.

NB You may use any letter more than once.

11 It may have used its feathers to frighten off members of the same species.

12 This species resembles a large flightless bird that exists today.

13 Finding this species made scientists revise their opinion of the brain power of dinosaurs.

List of Prehistoric Animals

A *Tongtianlong*

B *Tyrannosaurus Rex*

C *Deinonychus*

D *Ornithomimosaur*

Vanilla – the most wonderful flavor in the world

Vanilla is the most popular and widely used flavor in the world. And, yet, the vanilla orchid is only grown in a few countries. Below you'll discover why these countries are ideal and how the vanilla from each region differs.

Mexico

Vanilla (*Vanilla planifolia* Andrews) originated in Mexico and for centuries was the exclusive secret of the native Totonac Indians, who were later conquered by the Aztecs. The Aztecs, in turn, were conquered by the Spanish forces led by Cortez in 1520. He brought vanilla pods home to Spain, thus introducing the flavorful pods to the rest of the world.

However, Mexico remained the sole grower of vanilla for another 300 years. The particular relationship between the vanilla orchid and an indigenous bee called the Melipone was crucial. It was responsible for pollinating the flowers, resulting in fruit production.

Vanilla pods should be picked when the tip begins to turn yellow. The curing process gives the pods their characteristic brown color as well as their flavor and aroma. In Mexico, farmers cure the pods by wrapping them in blankets and straw mats and then placing them in ovens for 24 to 48 hours. After that, the pods are spread outdoors to absorb heat during the day and then placed in wooden boxes overnight. Once properly cured, they are stored to further develop the flavor. The entire curing process takes three to six months, making it a very labor-intensive process. Vanilla from Mexico has a flavor that combines creamy tones with a deep, spicy character, making it a

delicious complement to chocolate, cinnamon and other warm spices. It also works wonderfully in tomato sauces.

Madagascar

Around 1793, a vanilla plant was smuggled from Mexico to the Island of Reunion, east of Africa. For almost 50 years, the production of vanilla struggled. The vines grew successfully with beautiful blossoms but vanilla pods were infrequent. Without the Melipone bee, the flowers weren't being fertilized beyond occasional pollination by other insects. It wasn't until 1836 that Charles Morren, a Belgian botanist, discovered the pollination link between bee and plant. And then in 1841, Edmond Albius of Reunion developed an efficient method for fertilizing the flower by hand. Now, growers could choose the best flowers to pollinate, resulting in a healthier and higher quality vanilla pod.

Eventually, the plants arrived on the nearby island of Madagascar, where hand pollination proved its worth. Assisted by the climate and rich soil, hand pollination by the country's skilled farmers has enabled Madagascar to become the world's top vanilla producer in quantity and, many would argue, quality.

The curing process is similar to that in Mexico with one difference. The farmers initiate the process by immersing the green vanilla pods in hot water for some time. They then store them in sweat boxes before beginning the routine of spreading them outdoors during the day and packing them away at night. The different curing method used contributes to the overall flavor of the vanilla.

The sweet, creamy and mellow flavor is the one most people identify with vanilla. This flavor and the pod's ability to hold that flavor in both hot and cold applications make it an exceptional 'all-purpose' vanilla which is many people's first choice for a wide range of sweet recipes – from cooking and baking to ice creams and buttercreams.

Tahiti

Like the other countries, Tahiti's tropical climate makes it ideal for growing vanilla. However, Tahiti differs in the species of vanilla that is most common: *Vanilla tahitensis* Moore. This is the hybrid of two vanilla species introduced in the 1800s. These two species were skilfully crossed in the next few decades, to create the plump Tahitian vanilla pods we know today.

The curing process also differs from other countries'. Mature pods are first stacked in a cool place until they are completely brown (five to ten days) and then rinsed briefly in clear water, a unique characteristic of the method used in Tahiti. For the next month, growers expose the pods to the gentle morning sunlight. In the afternoon, they bind the pods in cloths and store them in crates until the next morning, to promote transpiration. Little by little, the vanilla pods lose weight and shrink. Throughout this phase, the workers carefully smooth and even out the pods with their fingers. Then after a month, the final step is to leave the pods in a shaded and well-ventilated spot for 40 days to lower their moisture content.

This species of orchid combined with Tahiti's advantageous climate and soil results in a vanilla that has fruity and sweet tones. Tahitian vanilla is especially vulnerable to heat and is therefore best used in refrigerated and frozen desserts, fruit pies and smoothies.

Indonesia

Indonesia is the second largest producer of vanilla. However, Indonesian production methods focus on quantity over quality. Unlike other regions, where vanilla beans are picked only when ripe, Indonesian growers harvest all the beans at one time, a labor-saving adjustment.

The curing process also features production shortcuts such as the use of propane heaters to speed up drying. The use of such heat, which chemically alters the beans, essentially 'burns off' flavor components while adding a smoky tone, resulting in a less complex taste and a sharper flavor. Indonesian vanilla works well when blended with vanillas from other regions and, because it's more economical, it makes the end product more affordable.

Questions 28-31

Look at the following statements (Questions 28-31) and the list of countries below.

Match each statement with the correct country, A, B, C or D.

Write the correct letter, A, B, C or D, in boxes 28-31 on your answer sheet.

28. The vanilla that is grown here was created from more than one type of vanilla plant.
29. This vanilla is often mixed with other types of vanilla.
30. Some people claim that this country produces the finest vanilla.
31. This vanilla goes well with both sweet and savoury ingredients.

List of Countries

A. Mexico

B. Madagascar

C. Tahiti

D. Indonesia

"A brief history of automata"

An automaton is a machine, usually made to resemble a person or animal, that operates on its own, once it has been started. Although few are constructed nowadays, they have a history stretching back well over two thousand years. Several myths show that the ancient Greeks were interested in the creation of automata. In one, Hephaestus, the god of all mechanical arts, was reputed to have made two female statues of pure gold which assisted him and accompanied him wherever he went. As well as giving automata a place in mythology, the Greeks almost certainly created some. These were probably activated by levers and powered by human action, although there are descriptions of steam and water being used as sources of power. Automata were sometimes intended as toys, or as tools for demonstrating basic scientific principles.

Other ancient cultures, too, seem to have developed automata. In Egypt, Ctesibius experimented with air pressure and pneumatic principles. One of his creations was a singing blackbird powered by water. A Chinese text of the third century BC describes a life-size, human-shaped figure that could walk rapidly, move its head up and down, sing and wink its eye.

Much later, Arab engineers of the ninth and thirteenth centuries wrote detailed treatises on how to build programmable musical fountains, mechanical servants, and elaborate clocks. A ninth-century ruler in Baghdad had a silver and gold tree with metal birds that sang. The art of creating automata developed considerably during the fifteenth century, linked with improvements in clock making: the mechanisms of automata and clocks had a great deal in common. Some truly remarkable automata were produced at this time. Muller was reputed to have made an artificial eagle which flew to greet the Emperor on his entry into Nuremberg, Germany, in 1470, then returned to perch on top of a city gate and, by stretching its wings and bowing, saluted the emperor on his arrival. Leonardo da Vinci made a lion in honour of the king of France, which advanced towards him, stopped, opened its chest with a claw and pointed to the French coat of arms.

Automata were normally very expensive toys for the very rich. They were made for royal or aristocratic patrons, to be viewed only by themselves and selected guests – who were expected to be impressed by their wealth. Automata were also created for public show, however, and many appeared on clock towers, such as the one in Bern, Switzerland, built in 1530.

During the eighteenth century, some watchmakers made automata to contribute to the progress of medicine and the natural sciences, particularly to investigate the mechanical laws governing the structure and movement of living things. Many of their creations simulated almost perfectly the complex structure of human beings and animals. Maillardet made extensive use of gearing and cogs to produce automata of horses, worked by turning a handle. Vaucanson

produced a duck made of gilded copper which ate, drank and quacked like a real duck. He also made a life-size female flute player. Air passes through the complex mechanism, causing the lips and fingers of the player to move naturally on the flute, opening and closing holes on it. This automaton had a repertoire of twelve tunes.

In another well-known piece, Merlin's silver swan made in 1773, the swan sits in a stream consisting of glass rods where small silver fish are swimming. When the clockwork is wound, a music box plays and the glass rods rotate, giving the impression of a flowing stream. The swan turns its head from side to side. It soon notices the fish and bends down to catch and eat one, then raises its head to the upright position. The mechanism still works.

One of the most skilled makers of automata was the Swiss watchmaker Jaquet-Droz. He produced three automata which, even today, are considered wonders of science and mechanical engineering. One of these, The Writer, simulates a boy sitting at a desk, dipping his pen into the ink and writing perfectly legibly.

Another Stunning creation of the eighteenth century was the Mechanical Theatre in the grounds of Austria's Hellbrunn Palace, home of the Archbishop of Salzburg. Designed by the miner Rosenegger, and completed in 1752, this depicts the nobility's idea of a perfect society, with every class in its proper place. The figures inside a palace depict eighteenth-century court life, while industrious activity is carried on in and around this building. A total of 141 mobile and 52 immobile little figures demonstrate all manner of trades of the period: building workers bring materials to the foreman, who drinks; butchers slaughter an ox; a barber shaves a man. A dancing bear

performs, guards march past the palace, a farmer pushes an old woman in a wheelbarrow over the road. The theatre shows great skill in clock making and water technology, consisting of hidden waterwheels, copper wiring and cogwheels.

During the nineteenth century, mass production techniques meant that automata could be made cheaply and easily, and they became toys for children rather than an expensive adult amusement. Between 1860 and 1910, small family businesses in Paris made thousands of clockwork automata and mechanical singing birds and exported them around the world. However, the twentieth century saw traditional forms of automata fall out of favour.

Questions 31-35

Look at the following descriptions (Questions 31-35) and the list of people below.

Match each statement with the correct person, A-G.

Write the correct letter, A-G, in boxes 31-35 on your answer sheet.

List of Descriptions

- 31. created an automaton that represented a bird in water interacting with its surroundings**
- 32. created an automaton that performed on a musical instrument**
- 33. produced documents about how to create automata**
- 34. created automata which required a human being to operate the mechanism**
- 35. used air and water power**

List of People

A Ctesibius

B Arab engineers

C da Vinci

D Maillardet

E Vaucanson

F Merlin

G Jaquet-Droz

Task - 1

The table gives information about department and online stores in Australia in 2011.

Summarise the information by selecting and reporting the main features, and make comparisons where relevant.

	Department Stores	Online Stores
<i>Number of Businesses</i>	67	368
<i>Profit (AUD)</i>	807	863
<i>Sales Revenue (AUD)</i>	12,700	13,400
<i>Growth</i>	.4%	.6%

PART 2 **Questions 11–20**

Questions 11 and 12

Choose **TWO** letters, **A–E**.

Which **TWO** warnings does Dan give about picking mushrooms?

- A** Don't pick more than one variety of mushroom at a time.
- B** Don't pick mushrooms near busy roads.
- C** Don't eat mushrooms given to you.
- D** Don't eat mushrooms while picking them.
- E** Don't pick old mushrooms.

Questions 13 and 14

Choose **TWO** letters, **A–E**.

Which **TWO** ideas about wild mushrooms does Dan say are correct?

- A** Mushrooms should always be peeled before eating.
- B** Mushrooms eaten by animals may be unsafe.
- C** Cooking destroys toxins in mushrooms.
- D** Brightly coloured mushrooms can be edible.
- E** All poisonous mushrooms have a bad smell.

PART 3 **Questions 21–30**

Questions 21 and 22

Choose **TWO** letters, **A–E**.

Which **TWO** opinions about the Luddites do the students express?

- A** Their actions were ineffective.
- B** They are still influential today.
- C** They have received unfair criticism.
- D** They were proved right.
- E** Their attitude is understandable.

Questions 23 and 24

Choose **TWO** letters, **A–E**.

Which **TWO** predictions about the future of work are the students doubtful about?

- A** Work will be more rewarding.
- B** Unemployment will fall.
- C** People will want to delay retiring.
- D** Working hours will be shorter.
- E** People will change jobs more frequently.