

READING PASSAGE 3

You should spend about 20 minutes on **Questions 27–40**, which are based on Reading Passage 3 below.

When evolution runs backwards

Evolution isn't supposed to run backwards – yet an increasing number of examples show that it does and that it can sometimes represent the future of a species

The description of any animal as an 'evolutionary throwback' is controversial. For the better part of a century, most biologists have been reluctant to use those words, mindful of a principle of evolution that says 'evolution cannot run backwards'. But as more and more examples come to light and modern genetics enters the scene, that principle is having to be rewritten. Not only are evolutionary throwbacks possible, they sometimes play an important role in the forward march of evolution.

The technical term for an evolutionary throwback is an 'atavism', from the Latin *atavus*, meaning forefather. The word has ugly connotations thanks largely to Cesare Lombroso, a 19th-century Italian medic who argued that criminals were born not made and could be identified by certain physical features that were throwbacks to a primitive, sub-human state.

While Lombroso was measuring criminals, a Belgian palaeontologist called Louis Dollo was studying fossil records and coming to the opposite conclusion. In 1890 he proposed that evolution was irreversible: that 'an organism is unable to return, even partially, to a previous stage already realised in the ranks of its ancestors'. Early 20th-century biologists came to a similar conclusion, though they qualified it

in terms of probability, stating that there is no reason why evolution cannot run backwards – it is just very unlikely. And so the idea of irreversibility in evolution stuck and came to be known as 'Dollo's law'.

If Dollo's law is right, atavisms should occur only very rarely, if at all. Yet almost since the idea took root, exceptions have been cropping up. In 1919, for example, a humpback whale with a pair of leg-like appendages over a metre long, complete with a full set of limb bones, was caught off Vancouver Island in Canada. Explorer Roy Chapman Andrews argued at the time that the whale must be a throwback to a land-living ancestor. 'I can see no other explanation,' he wrote in 1921.

Since then, so many other examples have been discovered that it no longer makes sense to say that evolution is as good as irreversible. And this poses a puzzle: how can characteristics that disappeared millions of years ago suddenly reappear? In 1994, Rudolf Raff and colleagues at Indiana University in the USA decided to use genetics to put a number on the probability of evolution going into reverse. They reasoned that while some evolutionary changes involve the loss of genes and are therefore irreversible, others may be the result of genes being switched off. If these