

detoxify free radicals formed from environmental toxins¹⁴.

Pyridines are only one class of chemicals that could be toxic to dopamine neurones. The key requirement is that they or one of their metabolites, like MPP⁺, should be selectively concentrated in dopamine neurones. The present search for an environmental molecule involved in the aetiology of Parkinson's disease may or may not be successful but it is to be hoped that the quest will re-awaken an interest in seeking specific molecular abnormalities associated with other major neurological and psychiatric disorders. □

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Palaeontology

Dinosaurs that fill the gaps

from Michael J. Benton

DINOSAURS arose in the late Triassic, 225 Myr ago; some of the early forms have become quite familiar, such as small carnivorous theropods (for example, *Coelophysis*), large herbivorous prosauropods (for example, *Plateosaurus*) and small herbivorous ornithomorphs (for example, *Fabrosaurus*). For a long time, it was thought that these early species were followed by a gap in the fossil record spanning about 30 Myr, after which there appear a selection of completely different dinosaurs. But the gap has now been filled by the re-dating of some dinosaur beds and because of new discoveries in the early middle Jurassic of Europe, India and China.

The first dinosaur faunas after the gap occur in the second half of the middle Jurassic in Europe (about 170 Myr BP). For example, the Bathonian horizons near Oxford, England have produced rare skeletons of the theropod *Megalosaurus*, as well as the giant herbivorous sauropod *Cetiosaurus* and the armoured stegosaur *Lexovisaurus*. Better known are the late Jurassic (about 155 Myr BP) dinosaurs *Allosaurus*, *Brontosaurus*, *Diplodocus* and *Stegosaurus* from North America.

The re-dating exercise has extended the age of dinosaur-bearing beds that were once placed at, or just below, the Triassic/Jurassic boundary, right through to the end of the early Jurassic (187 Myr BP). A combination of biostratigraphical evi-

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Solomon H. Snyder and Robert J. D'Amato are in the Departments of Neuroscience, Pharmacology and Experimental Therapeutics, and Psychiatry and Behavioral Sciences, Johns Hopkins University School of Medicine, 725 North Wolfe Street, Baltimore, Maryland 21205, USA.

dence (fossil pollen and spores, fish and footprints) and radiometrically determined ages of interbedded lavas has shown that these units cover a much wider time span than had been suspected^{1,2}. Intervals of time that were formerly considered to be devoid of dinosaurs are now known to have been populated over almost all the world by small theropods such as *Syntarsus*, medium-to-large prosauropods such as *Massospondylus* and *Euskelosaurus*, and small ornithomorphs such as *Fabrosaurus* and *Heterodontosaurus*.

The dinosaur faunas of the early Jurassic have also been extended by new finds, particularly of early sauropods, *Barapasaurus* from India³ and *Vulcanodon* from Zimbabwe⁴ (see figure) have been interpreted as intermediate between the prosauropods and the sauropods. These were large animals, 8–10 metres long, that probably walked habitually on all fours. Another sauropod of similar age is *Ohmdenosaurus* from Germany⁵, represented by only a few limb-bones.

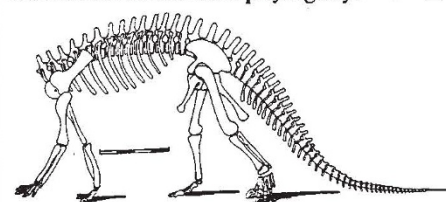
The middle Jurassic record of dinosaurs has been dramatically supplemented by new finds from China. In the past few years, several important new dinosaur specimens have been excavated from the Xiaoshaximiao Formation of the Sichuan Basin (age: Bathonian–Callovian, 176–163 Myr BP).

A skull and partial skeleton of one of

the earliest stegosaurs has been named *Huayangosaurus*⁶. The skull is primitive in several respects, and the armour consists of bony plates and spines. Until now, the earliest known stegosaurs came from Europe, but the new Chinese find indicates an eastern Asian origin for the group. Two sauropods have also been described from this formation: *Shunosaurus*^{7,8} and *Datousaurus*⁸. More than 10 skeletons of *Shunosaurus* have been found; this species was 7–8 m long, whereas *Datousaurus* was 14 m long. Both these sauropods show similarities to the English *Cetiosaurus*, which is of about the same age, but the skeletal remains of the Chinese animals are much more complete. These specimens, together with *Barapasaurus* and *Vulcanodon*, provide important new evidence that the sauropods arose from the prosauropods of the late Triassic and early Jurassic. Some palaeontologists had argued that the sauropods arose directly from Triassic thecodontians (the basal archosaur group), but that aspect of the theory that dinosaurs arose polyphyletically is now contradicted.

The fourth new dinosaur from the middle Jurassic of China is the ornithomorph *Xiaosaurus*⁹, a bipedal herbivore only one metre long. It might be related to *Fabrosaurus*, but the remains are fragmentary. In addition a carnivorous dinosaur *Xuanhanosaurus*¹⁰ has been identified on the basis of several limb-bones and vertebrae. The hand has the typical blade-like claws of a predator and, in general, this theropod seems to resemble the English *Megalosaurus*, which is of about the same age.

Palaeontologists, who have often been handicapped in their studies by gaps in the fossil record, will rejoice at these important new discoveries. Already, they are improving our understanding of the faunas and of dinosaur phylogeny. □



Reconstruction of *Vulcanodon karibaensis* Raath. Trunk and ilium adapted from *Barapasaurus*. Scale bar, 1 m.

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Michael J. Benton is in the Department of Geology, The Queen's University of Belfast, Belfast BT7 1NN, Northern Ireland, UK.