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Evolution and extinction through time

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BROADHURST, F. (1987). Evolution and extinction through time. *Proceedings of the Shropshire Geological Society*, **6**, 38–39. The account of a lecture describing past extinctions and evolution from the evidence of the fossil record.

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The lecture began by pointing out that all we know about past extinctions and evolution has been gained from the fossil record and he showed slides of specimens to show how well some are preserved. For instance some still show evidence of colour bands and dye remnants. Not only the ectoskeletons of invertebrates and skeletons of vertebrates are preserved but also trails and footprints. One slide showed a coalmine in Utah, the roof of which shows tracks of a dinosaur. Behavioural patterns of the dinosaurs can be deduced from the fossil evidence. The tracks seem to stop in front of a particular sequoia tree and it has been supposed that the dinosaurs were feeding there. Soft tissues too are sometimes preserved and slides were shown of a shrimp, spiders and a gigantic millipede.

The speaker went on to explain where such fossils might be found. One of the most spectacular venues is the Grand Canyon in the United States which is a mile-deep gorge cut by the Colorado River through stratified, sedimentary rocks. Dating shows that the uppermost layers are very much younger than those at the base of the stacks. Fossils collected from the various layers here and at other locations in the world produces a patchwork of information which can be pieced together to produce a jigsaw picture of the history of the Earth.

The Earth is believed to be about 4,500 Ma and the fossil record stretches back to 3500 Ma. For 7/8^{ths} of this time the record is dominated by unicellular organisms – algae and bacteria. Then in a relatively short time there was a rapid transition and multitudes of multicellular animal and plant species became apparent. What could have caused this?

It is widely believed that the Earth's earliest atmosphere was depleted of oxygen, but as the algae colonised the ancient seas they emitted oxygen into the atmosphere during photosynthesis, oxygen that could support the more efficient aerobic respiration of more complex organisms.

But another factor came into play also. At the beginning of the Palaeozoic Era there is evidence to suggest that the world's sea levels rose, creating shallow continental shelf seas. One suggestion for this phenomena has been that at this time the earth's land masses were grouped together as one supercontinent and this began to fragment. What were to become mid-oceanic ridges appeared and, as parts of the supercontinent moved apart, hot magma welled-up at the ridges. Hot rocks at the ridges are of low density and displace much water but as the rocks move away from the ridge and cool they contract and sink. At times of high levels of ridge activity therefore sea levels rise and during periods of relative inactivity sea levels fall.

The beginning of the Palaeozoic Era then gave evolving multicellular species oxygen and the right environment to succeed and the fragmentation of the continent produced geographical isolation which supported the evolution and divergence of species. Brachiopods became dominant in the shelf seas, most species being attached to the sea floor. Trilobites too became prolific. The evidence also suggests that predation pressure was much lower in those times than in later ages.

The Earth is spherical and it is plain to see that the fragments of the diverging supercontinent of the early Palaeozoic Era would eventually meet again with a resultant slowing of the plate tectonic processes and shutting down of the ridge system engine. This was the situation at the end of the Palaeozoic Era, about 225 million years ago. The ridges cooled, the colder rocks sank and the sea levels dropped, destroying the shelf seas and the habitats of many common species. The resultant supercontinent then broke up at the initiation of a new plate tectonic cycle, with the consequent re-establishment of extensive shelf seas. Different species became dominant in these seas – the ammonites and bivalves. These were more resilient to attack from predators which also became prevalent. The land became gradually dominated by reptiles. The Mesozoic Era had begun.

There is a hypothesis at the moment that at the end of the Mesozoic Era, a large meteorite with a diameter of about 10 km collided with the Earth. The effect was to throw so much dust and debris into the atmosphere that there was a permanent night for perhaps months or even years. Many species, such as the dinosaurs, perished and when the atmosphere cleared the small mammals took over niches previously filled by reptiles. However, the crater of the meteorite has not been found and this theory is lacking in proof. There is nevertheless strong evidence in the stratigraphical record to suggest that the sea-level at this time dropped considerably and this may have had a marked effect on the demise of the Mesozoic fauna.

From the beginning of the Cenozoic Era evolution has continued its path to give us the diversity of animal and plant species that are familiar to us and the dominant species now is – man.

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