A Look into the Fossil World

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Being a palaeontologist is like being a coroner except that all the witnesses are dead and all the evidence has been left out in the rain for 65 million years (Prothero 1998:4).

Palaeontologists have rock-hard evidence about life in the past: i.e. fossils. By studying fossils they are able to work out what extinct animals could have looked like, how they could have behaved and how they may have changed over time. Most of the palaeontological research of today, as in the past, is related to comparative anatomy: paleontologists describe, measure and compare the anatomy of fossil organisms in order to understand what they are, and how they evolved.

Fossils vary enormously in size, from trunks of sequoia trees and skeletons of large sauropod dinosaurs, which may reach several tons in weight, down to coccoliths, which are only a few microns in size (fig 1). The size itself determines a lot about the working method. Small fossils such as teeth, mice and single cell protozoans are usually studied under a stereoscope or an optical microscope. Even smaller fossils, like coccoliths, need larger magnification and for that electron microscopes are used. On the other hand, large vertebrate remains need no magnification equipment, yet other kinds of problems may occur, such as time-consuming preparation procedures and difficulties in transporting the studied material to other institutions for comparison. For studies that don't focus on the entire fossil, but just on the examination of the fine details of its structure, then electron microscopy is used once more.

Some fossil remains leave no doubt as to what they are and of what the organism might have looked like when it was alive. Many fossils however, are much more mysterious

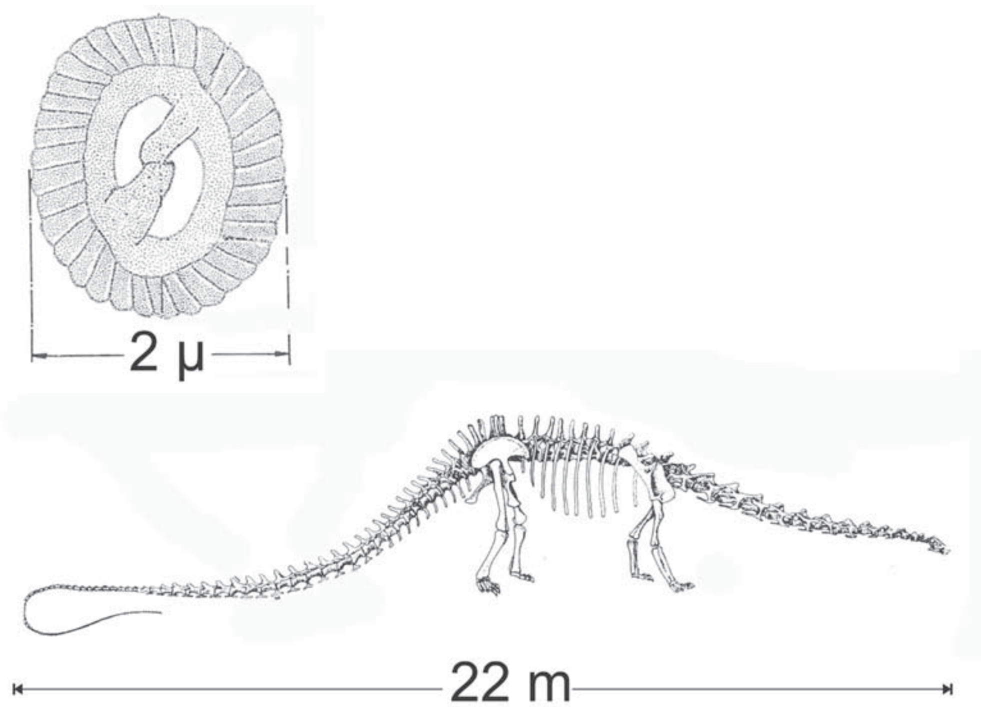

Figure 1. The size range of fossils is immense. The smaller fossils (e.g. the shields of coccoliths) are in many cases 12 million times smaller than a complete skeleton of a large dinosaur (e.g. a Diplodocus). That is about the size difference between a man and planet Earth.

and in order to investigate them, many researchers invented new ways of studying them. Actually, some of the greatest advances in palaeontology were made by people who successfully adapted equipment and techniques from other disciplines (Raup and Stanley 1985:44). Typical examples are the methods used for the investigation of the internal structures of the fossils. Ordinarily, palaeontologists dissect part of the fossil. However, for rare specimens where even a partial destruction cannot be afforded, X-radiography is used and in many cases it reveals things that could not be seen in any other way (Harbersetzer 1994: figs 12.4 to 12.9). Another advanced piece of medical equipment used to look at the internal structure of fossils, is a CT scan. This technique enables the reconstruction of the studied structures in three dimensional forms and in this way scientists have a virtual window into the fossils.

In order to investigate extinct species ways of life, two main approaches are followed: the form-function correlation and the biomechanical design analysis (Radin-

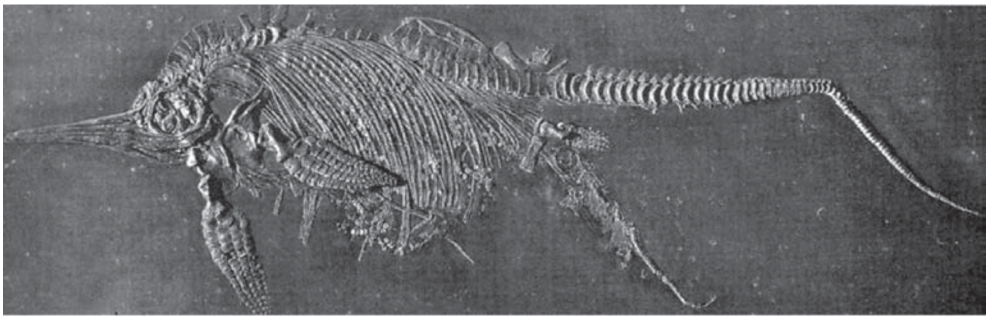

Figure 2. A fossil of Ichthyosaurus (an extinct marine reptile) from Holdmaden shale that died in the process of giving birth.

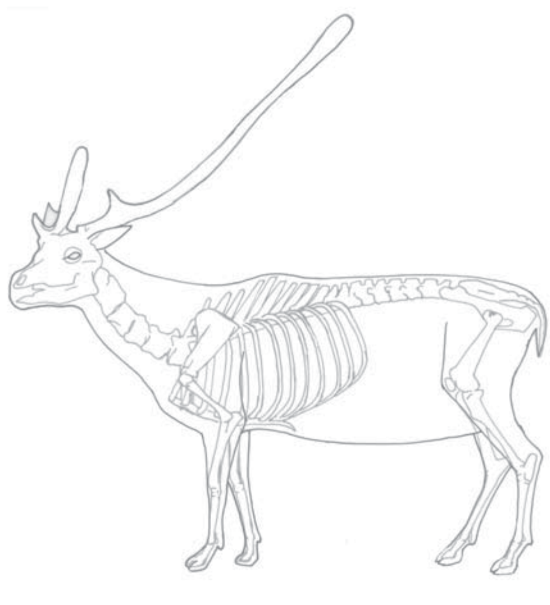

Figure 3. The reconstruction of the skeleton and external appearance of the extinct Cretan deer Candiacervus was based on the study of several thousand bones of this animal and its comparison with other fossilized and living ungulates (Van der Geer et al. 2005). Although the reconstruction is just a drawing, it is a pretty good summary of an otherwise rather specialized (and to most people uninteresting) study.

Figure 4. An early reconstruction of Ichthyosaurus (left). In the beginning scientists thought that the animal did not have a ventral fin and that its tail vertebra was straight. Only after the discovery of better specimens, which were preserving traces of their soft anatomy, were artists able to make more accurate reconstructions (right).

sky 1987:8). The first approach tries to see how a certain biological form works in a living animal and then exploits its function to similar forms of fossil organisms. The second approach examines the fossil forms in a mechanical (based on human-made constructions) or a theoretical way (based on the principles of physics).

Very useful sources for the better understanding of life in the past are the tracts of animals preserved in sediment. A tract can tell you a lot about an animal: how big it was, how fast it ran, in what order it moved its legs and so on.

Palaeopathological evidence (the evidence of ancient diseases or accidents) is equally important, not only because it informs us about the diseases or injuries of extinct organisms, but also because it gives us a rare insight into animal life in the past (e.g. fig. 2) that we could never have guessed otherwise (Rothschild & Martin 1992: 289).

Most fossil species remain dry scientific descriptions, in papers only known to a small elite group of experts. There are certain species though that attract more attention and therefore skeletal mounts and “life” reconstructions are made (figures 3 and 4). Actually, most extinct species are known to the general public only as mounts or reconstructions. To arrange the bones in a life-posture or to put flesh on bones and shells is a fascinating but tricky business. As a rule of thumb scientists and artists follow the uniformity principle - the present is the key to understanding the past - and base their work on living species. That however, can lead to false attribution of present day features to past organisms. The scientific data collected from all kinds of analyses, such as the ones mentioned above, can restrict any mistakes. However, misleading reconstructions, like the one featured in figure 4 , illustrate that our view of the past is always just an interpretation of present day knowledge, which changes whenever new findings or new theories come to light.

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