

Fossil fish of the Welsh Borderlands

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The lecture was introduced by pointing out the difference between fossil collectors of a century ago and those of modern times. Victorian age collectors would find specimens and deposit them in museums; scant regard would have been taken of how the specimens lived and fitted into their ecological niches. By contrast, modern geologists use collecting techniques to build up as complete a picture as possible of the specimens and their environments, and how the environments and specimens change over time.

Fossil fish can be divided into five groups, as follows:

1. The **Agnathans**, primitive fish without jaws, which are further subdivided into:
 - a. *Heterostrachans*
 - b. *Cephalaspids*
 - c. *Anaspids*
 - d. *Phaelodonts*
2. **Placoderms** which are now all extinct.
3. **Acanthodians** which are all extinct now.
4. **Chondrichthyes**, the sharks.
5. **Osteichthyes**, the bony fish, the group to which nearly all the fish in the world today belong and which are subdivided into:
 - a. Ray-finned fish
 - b. Lobe-finned fish

The most important groups of these in the Welsh Borderlands are the Agnathans and the Acanthodians.

Fossil fish first occurred in the middle-Ordovician; the earliest fossils are of the Heterostrachan group of the Agnathans.

Representatives of this group have been found world-wide. They are typified by their covering of tesserae, small tooth-like bony plates - the Welsh Borderlands is one of the most important areas for finding specimens and the evolutionary changes, such as the development of the tesserae can be studied. The earliest examples came from a marine environment but there is some dispute over the environment of some of the later specimens. Later examples indicate greater differentiation of the tesserae until examples from the Silurian, such as the Pteraspis, are normally found with individual, bony plates which exhibit growth ridges.

Maggie Rowlands' colleague, Peter Tarrant, had collected from one particular site in Shropshire for nearly twenty years and this collection can be seen in Ludlow Museum. They arranged a multi-disciplinary project on this site to collect bed by bed to add to Peter's collection and to find out more of what happened from the top of the Silurian to the base of the Devonian. They now have a good picture of what happened, as follows.

The area was mud flats cut through by channels, each having slightly different fauna assemblages. A major change occurred at the boundary of the Silurian and the Devonian and the fauna changed almost completely. The environment became much wetter and there was an ingress of sandstones. All through the section are fluvial sediments and thus these fish were living in a freshwater environment. Geologists have generally agreed that all early fish were from marine environments, but Maggie and Peter are convinced that the Welsh Borderland discovery is of freshwater types and this is supported by the palaeogeography of the area - this raises many questions, but one theory of explanation is that

here fish were taking over new freshwater niches and this is supported by the diversity of forms.

Maggie explained that her personal preference was for Cephalaspids, examples of which she described in detail. Examples of this bottom-dweller are rarely found complete in the Welsh Borderlands though they are in sandstones of Scotland. The evolution through time was from examples with a large solid head and body shields to examples bearing elongated bony scales. Maggie reported that she and Peter had been very successful at collecting Hemicyclaspids from a site near Ludlow, having collected about ten times as many than had been collected before and this had allowed them to carry out statistical research and make environmental interpretations.

Anaspids are widespread but quite rare. They are found in freshwater deposits and occur from the top part of the Silurian through to the early Devonian. One survivor is found in the upper Devonian in Canada. This group is typified by small fishes covered by very thin dermal armour of very elongated scales but as the group evolved these scales were lost. The tail appears to be upside down and caused problems with orientation of the first specimens found.

Maggie could not show an example of the fourth group, the Phaelodonts, typified by a body covered with small button-like denticles. Members of this group are very useful for stratigraphy. They are found in the Ludlow Bone Bed. Examples were first found here in the 1830s and caused much excitement among geologists of the time who thought they had found evidence for the first vertebrates. This deposit is most likely a death assemblage of fish denticles and bones.

Maggie described Placoderms as having the first primitive jaws and fins and a thick bony shell. Some of the specimens have fins that are bony and jointed and perhaps enabled the animals to drag themselves along the bottom of the lake floor.

The Acanthodians had true jaws, as have fish today. They were covered in tiny scales and they were recognised by solid bony spines protruding along the front edge of each fin. They have been found quite low down in the Silurian through the Devonian and Maggie showed a slide of a Carboniferous example, *Gyrocanthus*. They became extinct in the Permian. In the Welsh

Borderlands usually only the spines can be found but these are very common.

The next group are the sharks. Some geologists are searching for specimens from the Devonian and fossilised teeth from these ages are the same as modern sharks teeth. Sharks have a cartilaginous skeleton which does not preserve well, but bony teeth are very common. Maggie described in detail work being carried out on sharks at the Bearsden site in Glasgow by Stan Wood. Many new fossil species have been found, some of which she described in fine detail.

The last group of the fossil fishes is the Bony Fish, which are typified by a bony skeleton and scales. These fish occur worldwide and in all types of aqueous niche. Lobe-finned fishes probably gave rise to tetrapods - the amphibians. Lingering members of the Lobe-finned group are Coelacanth and lung-fish. The Ray-finned fish first evolved in the middle-Devonian, and the modern bony fishes, the Teleosts, first appeared in the late Cretaceous. Maggie showed many significant examples of this group and described different sites where early examples could be found.

Maggie went on to describe work at the Bearsden Quarry in Glasgow with Stan Wood and she described in detail how specimens were extracted. Stan Wood's collection is now touring the country. She also looked to the future and what she would like to tackle and at this point the audience joined in with a lively discussion session.

Peter Tarrant is in the process of writing two substantial papers on Heterostrachans of the Welsh Borderlands and one is to be published in the near future.

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