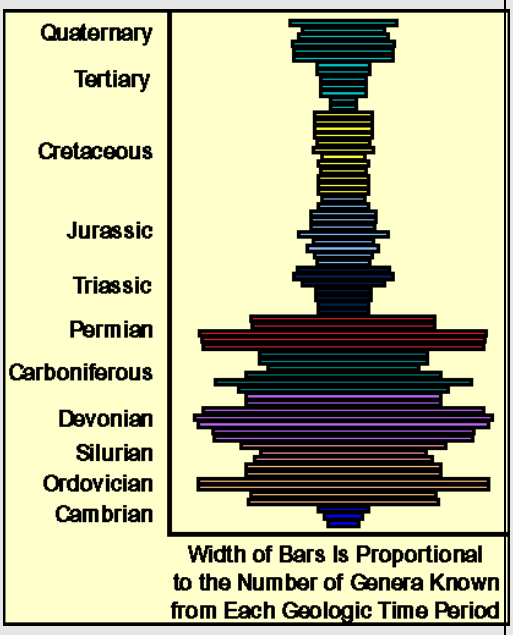
ADAPTATIONS OF BRACHIOPODS

ADAPTIVE RADIATION

Brachiopods have evolved in a **variety of different shapes and sizes** as a response to **the environment** they lived in and the **selection pressures** in that environment.

Specific adaptations are linked to t**hree** main environments: **turbulent waters, quiet water and a soft, muddy substrate.**

A Commisure is the margin at the posterior between the valves. It may be curved, folded or zigzagged.



ADAPTATION TO TURBULENT WATERS

Adaptation	Possible reason for adaptation
A large pedicle opening/foramen	To support the protrusion of a large muscular pedicle for secure attachment to a substrate in high energy waters. More muscle and strength is need for stability and to align the brachiopod to the current
Strongly ribbed valves	Add strength to the shell to protect against wave action.
A folded or zigzagged margin/Commisure	To reduce the amount and particle size of sediment entering the shells when the valves are open.
A thick heavy shell (*if pedicle is absent*)	To provide extra stability on the substrate and prevent rolling in the current.

A large pedicle foramen

Corrugated/zigzagged Commisure/margin

Strongly ribbed shell

A large pedicle foramen

A thick heavy shell

A thick heavy shell

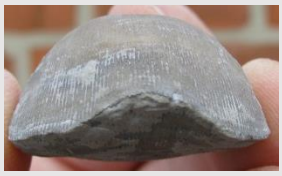
ADAPTATION TO QUIET WATERS

Adaptation	Possible reason for adaptation
May have a median fold and sulcus	**To separate currents entering and leaving the animal and prevent the mixing of fresh water and waste. This is both for efficiency, hygiene and prevents the entering of sediment.**
May have an extension of the valves to form `wings`	**This provides a large surface area to prevent the shell sinking into the sediment (quiet waters are often muddy environments).**
Smooth to weekly ribbed surface texture	**No need to be robust in quiet conditions with no wave action.**
No pedicle opening	**The pedicle is not needed for attachment, they are free lying.**

Weakly ribbed shell

No pedicle foramen or pedicle

Strong fold/sulcus



Weakly ribbed shell

No pedicle foramen or pedicle

Strong fold/sulcus

Weakly ribbed shell

No pedicle foramen or pedicle

Strong fold/sulcus

Extension to valves to make wings

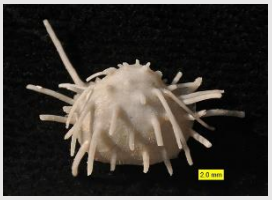
No pedicle foramen or pedicle

Strong fold/sulcus

Extension to valves to make wings

ADAPTATION TO SOFT, MUDDY ENVIRONMENTS (ALSO QUIET WATER)

Adaptation	Possible reason for adaptation
Valves are flat with a large resting area	**This provides a large surface area to prevent sinking into the sediment.**
One part of the margin maybe turned upwards away from the sediment (a large fold).	**This ensures that some part of the shell remains out of the sediment for feeding.**



On part of the valve is folded up out of sediment.

Weakly ribbed

Valves are relatively flat to rest on sediment

No pedicle

Fold and sulcus

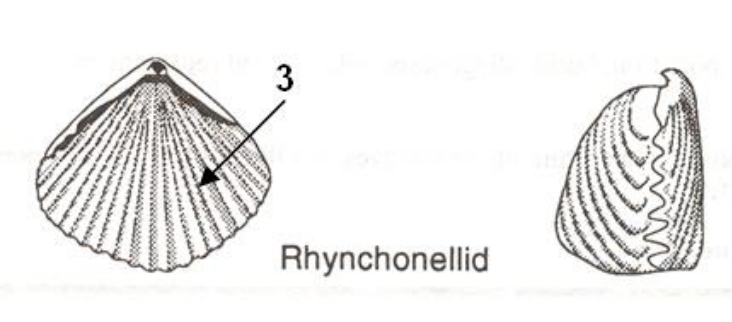
Extension to the valve forms wings

TYPES OF BRACHIOPOD

Brachiopods are classed on their external morphology since their internal structures are often so difficult to see and are not always preserved.

RHYNCHONELLIDS ~ HIGH ENERGY TURBULENT WATER BRACHIOPODS

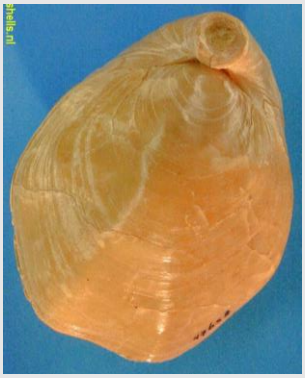
- **Extant: Ordovician to recent**
- **Most abundant / acme: Mesozoic**
- Usually, a **pedicle**, showing their attachment to the sea floor. **
- Strong radiating ribs are common in this group. They were able to cope with high-energy water. **
- The **Commisure is zigzagged** so that the edge of the shell stops larger particles getting in. **
- Maybe a thick heavy shell, depend on the species in question?**
- They have a strong **fold and a sulcus.** Clearly developed in species of **Rhynchonella**, common in the **Jurassic.**
- **Hinge line is short** and curved (**astrophic**), for streamlining. Also, no soft sediment so no need for a large surface area.
- The Rhynchonellids are **biconvex** with **a bulbous shell.**

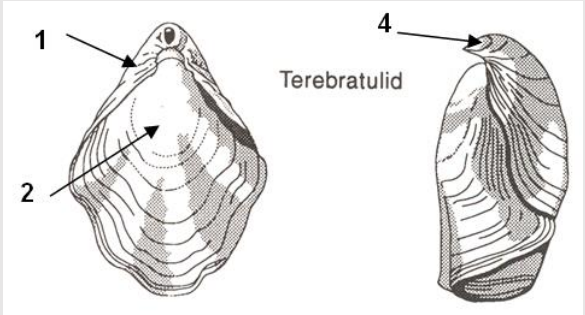


TEREBRATULIDS ~ HIGH ENERGY TURBULENT WATER BRACHIOPODS

- **Extant: Devonian to recent**
- **Most abundant / acme: Common today (Cenozoic) but also common in the Jurassic and Cetaceous (Mesozoic)**
- A circular **pedicle foramen** for a pedicle showing it attached to the seafloor. **
- Maybe a thick heavy shell, depend on the species in question?**
- **Hinge line is short** and curved (**astrophic**), for streamlining. Also, no soft sediment so no need for a large surface area.
- The valves are **smooth and ovoid**, giving them **streamlining** in high energy water.
- Many are found on **oolites and sandstones** showing they did live in **high energy water**.
- They can have a **fold and a sulcus.**
- The **Commisure can be zigzagged** so that the edge of the shell stops larger particles getting in.

** DEPENDS on ONS SPECIES HERE

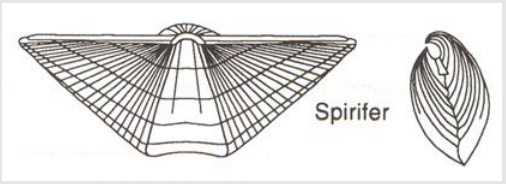




SPIRIFERIDS~ LOW ENERGY QUIET WATER BRACHIOPODS

- **Extinct: Ordovician to Jurassic**
- **Most abundant / acme: Carboniferous (Paleozoic)**
- They have a **long straight (strophic hinge** line) that results in an e**xtension** of the valves to form '**wings'**. **
- They often have **a fold and sulcus** in the middle of each valve. **
- They have no pedicle foramen as they were free lying on the sediment. **
- They may have only **weak ribbing** as they do not need to be robust. **
- The folded edge of the shell remains clear of sediment, above the sediment for filter feeding and respiration. **

  The characterizing feature of a Spiriferid is that the **Lophophore support system** is a **spiral shape**, called **spirella.** This gives Spiriferid their name, '**spiral-bearers'**. The spiralled lophophore is often preserved as a **thin ribbon of calcite** tightly coiled within the shell.



PRODUCTIDS ~ LOW ENERGY QUIET WATER BRACHIOPODS LIVING ON SOFT SUBSTRATE

- **Extinct: Devonian to Permian**
- **Most abundant / acme: Carboniferous (Paleozoic)**
- The shell is **semicircular and thick** with a **straight hinge** line (**strophic**).
- They have no pedicle. **
- They are either anchored by **hollow tabular spines** into a soft ooze ort mud on the sea floor. Or, they **rest on the substrate** with their **strophic hinge line.**
- They typically have one flat brachial valve (upper/dorsal) and one lower highly convex pedicle valve (ventral). This helps the organism stay in place on the sea floor. **
- Depending on the species, there may be a margin folded up away from the sediment for feeding and respiration. DEPENDS ON SPECIES **

The genus**, Productus**, was very abundant with a **wide geographical range**. Some species are **large - over 60mm across. They had both valves radiated. The spines are fragile.**