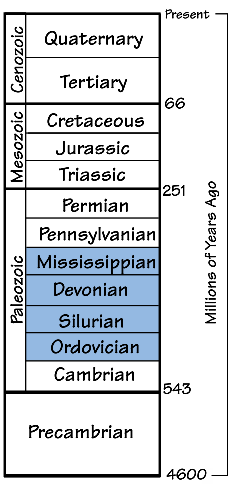
Fossils of the Inland Basin

Region 1

see *Fossils*, p.91 for more on **stromatolites**

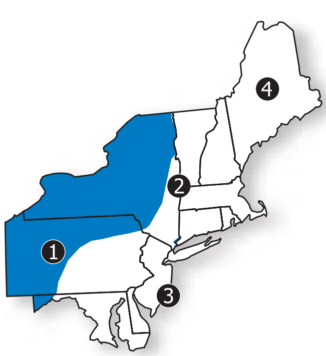
The Inland Basin region primarily contains the story of the evolution of marine and coastal plant life superimposed on the story of mountain-building events, associated sediments deposited in the inland ocean, and changes in relative sea level. The earliest fossils in the Inland Basin region are ***stromatolites***, formed from cyanobacteria in the warm shallow Iapetus Ocean. Stromatolites are preserved in late Cambrian rocks, found to the southwest and southeast of the Adirondacks. Abundant marine fossils are found in Ordovician through Mississippian rocks formed in the inland ocean that existed through most of the Paleozoic. Pennsylvanian-age rocks preserve an excellent record of plant material.



Ordovician to Mississippian

Ordovician, Silurian and Devonian marine fossils of the Inland Basin, especially in New York, are world-famous for their quantity and quality. Ordovician-to-Devonian fossil assemblages are nearly always dominated numerically by brachiopods, and may also contain trilobites, sea lilies, corals, clams and other mollusks, and many other less common organisms. What is perhaps the most striking is the differences in fossil assemblages from different types of paleoenvironments. The type of environment determined the types of organisms that lived there, and thus the fossils that are preserved in the rock.

Clear, shallow marine environments, generally preserved as limestones, often have abundant ***corals*** *(Figure 4.3)*, ***bryozoans*** *(Figure 4.2)* and ***sea lilies*** *(Figure 4.4)*. Corals, bryozoans and sea lilies are all filter feeders, collecting fine particles from the water. These environments form in places and at times when there is little sediment settling in the water. Western New York and Pennsylvania, far from the Taconic and Acadian highlands where sediment was being eroded into the inland ocean, preserve rocks recording this environment. Also, throughout the Inland Basin, and relatively undeformed sections of the Appalachian/Piedmont, rocks formed in-between mountain-building events record clear, shallow marine conditions because there was no highland to erode sediment into the basin.



BRYOZOANS

Many animals that are not easy to study, and in some cases even recognize without the aid of a microscope, have a long and exemplary fossil record. One such group is the bryozoans, colonial marine animals that have evolved a wide variety of skeletal shapes and textures. One of the more common Paleozoic varieties looks like fine mesh cloth with numerous tiny holes in which the individual animals in the colony lived. Small tentacles on the animals captured food particles from the water.

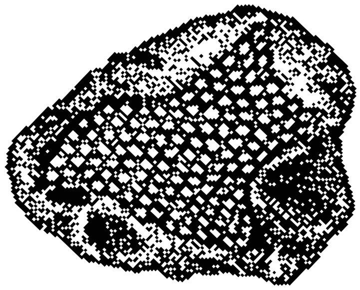


Figure 4.2: Bryozoan, mid-Devonian fenestellid (4 cm wide).

Though functioning somewhat like a coral, and often found in similar environments, bryozoans are more closely related to brachiopods.

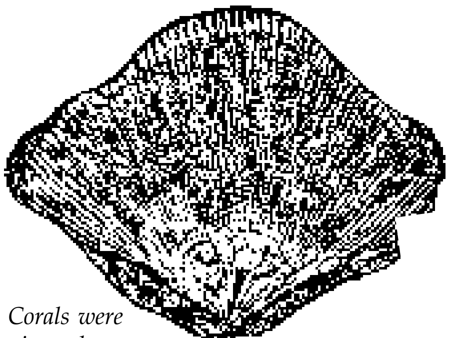


Figure 4.3: Corals were abundant in clear, shallow marine Paleozoic seas. ABOVE: tabulate coral, mid-Devonian Favosites, *cross-section (11.5 cm wide); BELOW: rugose coral, mid-Devonian* Heliophyllum halli *(7 cm long).*

CORALS

Corals have been important and common elements of clear, shallow marine waters since the Ordovician. Ordovician, Silurian and Devonian rocks of the Inland Basin region have numerous examples of reefs or other shallow environments in which colonial 'tabulate' corals are common. Even more abundant in these rocks is the solitary 'rugose' or horn coral. Both tabulate and rugose corals became extinct at the end of the Permian. Soon after, a new type of coral had appeared which are present today: the **scleractinians**. *Though scleractinians look somewhat similar to rugose and tabulate corals, each group possesses distinctive features in the shape of the skeletal cup holding the individual animals.*

Corals have been an important creator of limestone and also, as reef-builders, an important part of building homes for a diverse number of different organisms.

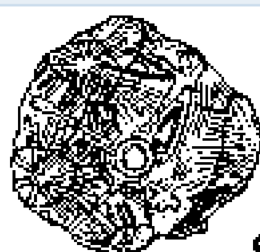
see Fossils, p.93 for more on **scleractinian corals**

SEA LILIES
BLASTOIDS & CYSTOIDS

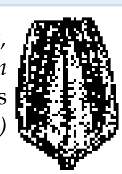
Several groups of stemmed echinoderms appeared in the early Paleozoic, including crinoids, blastoids and cystoids. All have in common 5-fold symmetry and a head (calyx) held off the sea floor by a stem, where it collected organic particles from the water. The stems, which are the most often preserved part, are made of a series of stacked discs that look like Cheerios. Upon the death of the organism, the stems often fall apart and the individual disks are seen separated in the rock. Feathery arms radiated from the head of crinoids, looking something like a lily flower on a stem. Thus, crinoids are commonly called 'sea lilies', though they are not actually plants.

The head and arms of crinoids are rarely found preserved, while the heads of blastoids and cystoids, on the other hand, are commonly found whole. Though blastoids and cystoids went extinct at the end of the Paleozoic, crinoids still exist today.

crinoid stems, mid-Devonian (largest is 4 cm long)



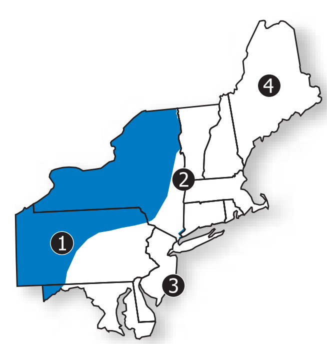
crinoid cup, mid-Devonian Dolatocrinus *(4 cm diameter)*



blastoid theca, mid-Devonian Devonoblastus *(2 cm wide)*

cystoid theca, Silurian Caryocrinites ornatus *(5 cm diameter)*

Figure 4.4: Stalked echinoderms, common in clear, shallow marine environments.



Rocks that preserve muddy, well-oxygenated environments are especially common in the middle of the Inland Basin, away from the shoreline, such as the late Ordovician and the middle Devonian rocks in central to western New York and western Pennsylvania.

see Fossils, p.94 and 95, to learn about **cephalopods and clams**

Brachiopods *have a special structure formed by tissue with thousands of tiny hair-like tentacles stretched along a coiled piece of internal shell material. These tentacles catch and move small particles towards their mouth. This body plan is very different from that of bivalves, which have a larger fleshy body and collect particles with their gills.*

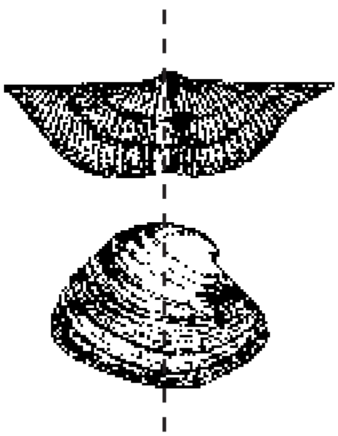
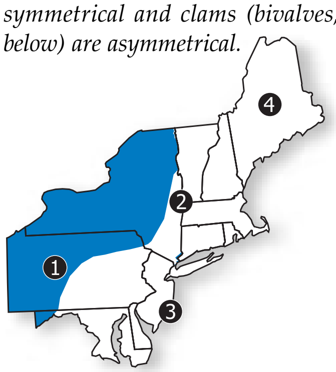


Figure 4.6: Brachiopods (top) are symmetrical and clams (bivalves, below) are asymmetrical.



Muddy, well-oxygenated environments, generally preserved as gray shales, often have abundant **brachiopods**, **trilobites** *(Figure 4.8)*, ***cephalopods*** and small ***clams*** *(Figure 4.7)*. Small or flattened brachiopods that are not likely to sink into the mud, such as *Mucrospirifer*, are common in this environment.

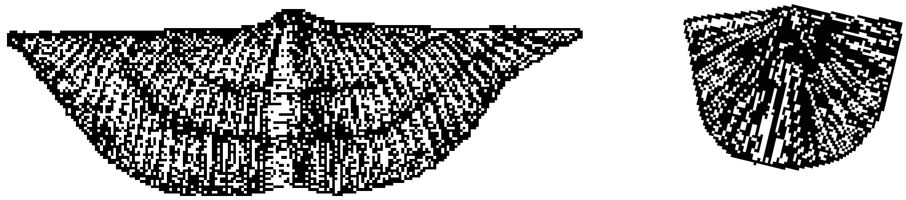


Figure 4.5: LEFT: brachiopod, Mid Devonian Mucrospirifer *(5 cm wide). RIGHT: brachiopod, Ordovician* Rafinesquina (2.5 cm wide).

BRACHIOPODS

Brachiopods look somewhat similar to clams you might find at the beach today. However, from the soft parts of modern brachiopods, we know that they are completely unrelated to the animals that make 'shells' that are common today (bivalves); brachiopods are rare today and are unlikely to wash up on shore. Brachiopods are the most common fossil in Paleozoic sedimentary rocks and are therefore very common in the Inland Basin region where these rocks are preserved.

Brachiopod or bivalve?

Brachiopods and bivalves both have a pair of hinged shells ('valves') to protect themselves while feeding. To tell the difference between a brachiopod and a bivalve, look for symmetry on the surface of the shells. Brachiopods are symmetrical across the shell, like your face. Bivalves are asymmetrical (Figure 4.6). The exception would be a deformed brachiopod, which might be found in the relatively more compressed rocks of the Appalachian/Piedmont. The size of the valves also helps to identify to which organism the shell belongs. Bivalve valves are of equal size and mirror image shapes. Brachiopods bottom valves, however, are slightly bigger and often have a different shape.

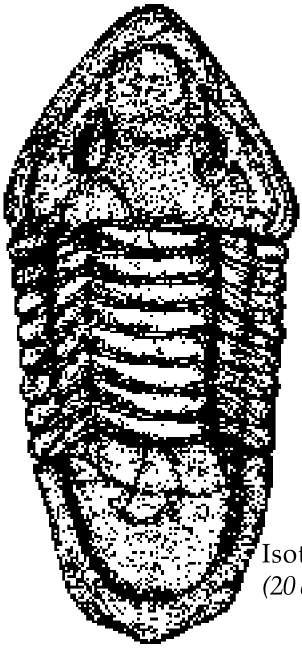
bivalve (clam)

ammonoid (cephalopod)

Figure 4.7: Mollusks found in muddy,well-oxygenated environments: (clockwise) bivalve, mid Devonian Modiomorpha *(5.5 cm); gastropod, mid Devonian,* Platyceras *(4 cm); nautiloid cephalopod, early-mid Devonian (20.5 cm long); ammonoid, mid Devonian,* Tornoceras *(5.5 cm).*

gastropod (snail)

nautiloid (cephalopod)

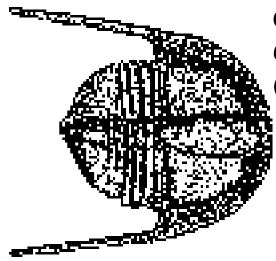


TRILOBITES

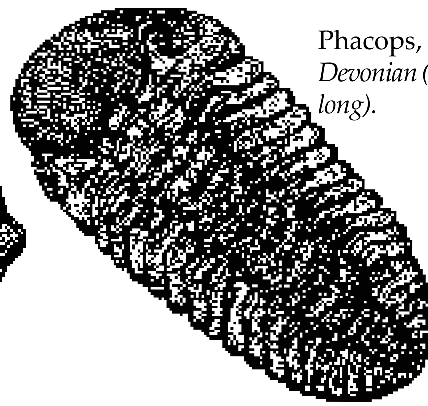
These marine organisms were bottom dwellers, present in a variety of environments and in Paleozoic rocks in the Inland Basin, Appalachian/Piedmont, and a few locations in the Exotic Terrane. Trilobites had a well-defined head, often with large eyes that had multiple lenses usually visible with the naked eye. A primitive arthropod distantly related to horseshoe crabs, trilobites have been extinct since the end of the Paleozoic.

Figure 4.8: Trilobites were abundant in muddy, well-oxygenated environments in the early to mid Paleozoic.

Isotelus, *Ordovician (20 cm long).*



Cryptolithus, *Ordovician (1.5 cm).*



Phacops, *mid-Devonian (7 cm long).*

Dalmanites, *Silurian (6 cm long).*

Like crabs and lobsters, **trilobites** *molted their exoskeleton when they grew. Most fossils of trilobites are actually molts, often broken as they were shed off the trilobite. Thus, it is common to find only parts of trilobites, such as the head, mid-section or tail.*

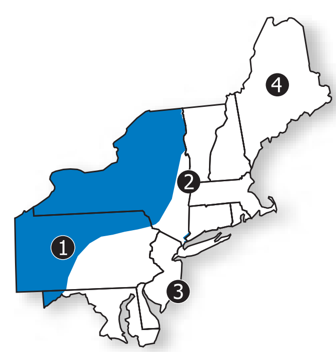
<u>Muddy, oxygen-poor marine environments</u> are preserved as black shales, which often are completely lacking fossils, though plankton such as ***graptolites*** may be found *(Figure 4.9)*. This environment forms in stagnant basins and areas where there is abundant organic material settling to the bottom; sometimes it is apparently associated with basin deepening due to down-warping crust during stages of rapid mountain building.

Inland Basin rocks preserving ***muddy, oxygen-poor environments*** *include especially some late Ordovician and mid Devonian rocks, formed at the beginning of the Taconic and Acadian mountain-building events.*

GRAPTOLITES

Graptolites are a group of extinct, puzzling planktonic organisms found in dark shales. No clear soft parts have been found, though they appear to be related to a minor group of modern colonial invertebrate organisms known as pterobranchs. They are relatively common fossils in the Ordovician rocks of the Inland Basin.

Figure 4.9: graptolites, Ordovician Didymograptus *(2 cm long).*



High energy, **silty or sandy environments** *were common near the eastern shoreline of the inland sea, and are preserved in places such as the mid-Devonian rocks of the Catskills. As the inland basin gradually filled over time, the shoreline moved westward. Thus, fossil-rich siltstones and sandstones are also found in the late Devonian rocks of southern New York and the late Devonian and Mississippian rocks of northern Pennsylvania.*

<u>Silty to sandy marine environments,</u> preserved as siltstone and sandstones, may contain abundant rugose corals, large thick-shelled brachiopods, sea lilies, and bryozoans and lesser amounts of many other organisms such as ***sponges*** *(Figure 4.10)*. These organisms were robust filter feeders.

SPONGES

Technically known as poriferans, sponges come in a variety of shapes and body forms, and have been around at least since the Cambrian. Entire sponges are rarely preserved, but their tiny skeletal pieces, called 'spicules,' are common in sedimentary rocks. Glass sponges (with skeletons made of silica) are a particular group of sponges that existed from the Cambrian to the present. Though now largely found in deep water environments, they were sometimes part of shallow marine environments in the Paleozoic. The best-known glass sponge fossils are from New York Devonian sedimentary rocks of the Inland Basin.

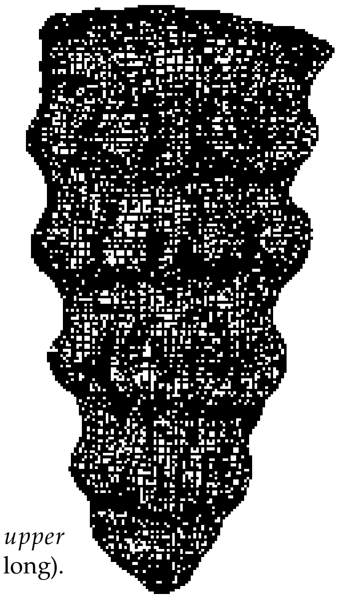


Figure 4.10: Glass sponge, upper Devonian Hydnoceras (16 cm long).

see Rocks, p.35, for more on rocks preserving **hypersaline** *environments.*

Evaporites *are sedimentary rocks created by the precipitation of minerals directly from seawater, including gypsum, carbonate and halite.*

<u>Hypersaline marine environments</u> are preserved as ***evaporite*** deposits. Because ***hypersaline*** environments have higher than normal levels of salt, most organisms cannot survive. Unusually tolerant organisms generally inhabit these environments. ***Eurypterids***, or sea scorpions, were able to withstand the salty water and are well-preserved fossils in rocks of this environment *(Figure 4.11)*.

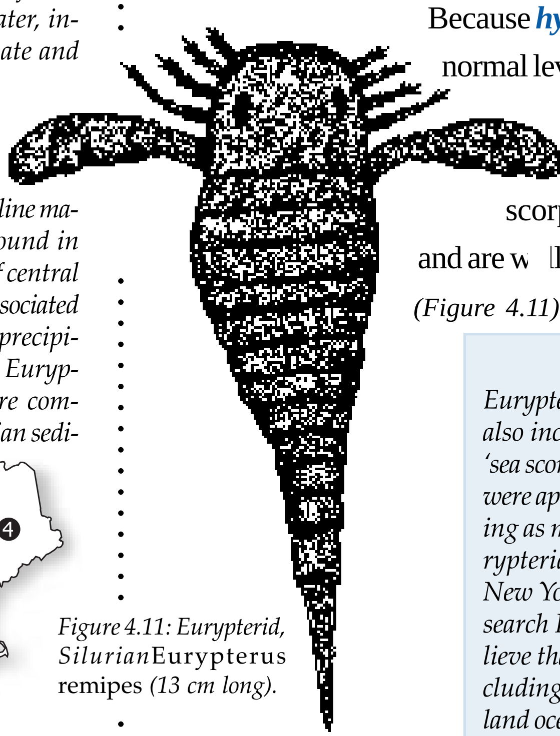
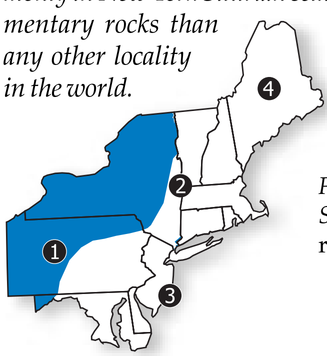


Figure 4.11: Eurypterid, Silurian Eurypterus remipes *(13 cm long).*

Rocks preserving hypersaline marine environments are found in the Silurian dolostones of central and western New York, associated with large salt deposits precipitated in the inland ocean. Eurypterids are preserved more commonly in New York Silurian sedimentary rocks than any other locality in the world.



EURYPTERIDS

Eurypterids are an extinct group of arthropods, the group that also includes horseshoe crabs. Though known by the name 'sea scorpions', they were not actually scorpions. Eurypterids were apparently one of the great predators of their time, reaching as much as 3 meters in length. The largest complete eurypterid in the world, about 1.3 meters long, was found in New York State and is on display at the Paleontological Research Institution in Ithaca, New York. Paleontologists believe that eurypterids lived in near shore environments, including salty, shallow sea environments like the Silurian inland ocean.

Intertidal and river environments are often preserved as coarse grained sandstones and conglomerates. Rocks preserving these environments commonly contain plant fossils. When land plants first evolved in the Silurian, they were non-vascular, relatively small plants with only very tiny, hair-like roots, if any. Gradually plants began to evolve and diversify. ***Vascular*** plants became more common, leading to taller plants and larger, more extensive root systems. By the Devonian, woody matter from vascular plants is commonly found in the fossil record of the Northeast. The Gilboa forest, in mid-Devonian shales of Scoharie Creek Forest in central New York, contains fossilized tree stumps and is the oldest preserved ***forest***. More commonly, though, Devonian plant material is restricted to thin carbonized sticks.

Early **forests** *were composed of quite different types of plants than today's forests. For example, progymnosperms are a group of plants with spores rather than true seeds; those with two different forms of spores probably were the ancestors to gymnosperms. An important progymnosperm was* Archaeopteris, *a leafy tree of the late Devonian.*

Rocks preserving **intertidal, land,** *or* **river environments** *tend to be found close to the mountain range that existed on the eastern side of the inland ocean or associated with the deltas that formed as sediments eroded off the highlands.*

Vascular *plants have stiffer tissues that help support them and transport nutrients and water to all parts of the plant. This allows vascular plants to grow taller and further from water.*

PROBLEMATICA

There exists a formal Latin name even for enigmatic fossil groups: problematica. Most Problematica are late Precambrian or Paleozoic organisms, all of which have become extinct and so provide no modern organism that would enable us to clarify their anatomy and genetics. Two commonly seen Problematica fossils in the Inland Basin sedimentary rocks are hyolithids (Figure 4.12), conical tubes with a shell covering; and tentaculitids (Figure 4.13), small, cone-shaped, ribbed shells. Both have been considered mollusks in the past, though hyolithids are believed by some to be a distinct phylum.

Figure 4.12: Hyolithid, mid-Ordovician (2 cm).

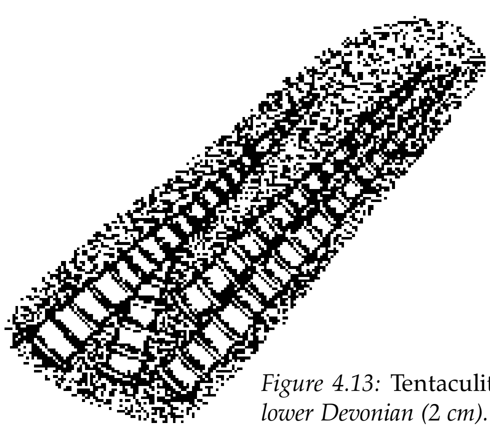
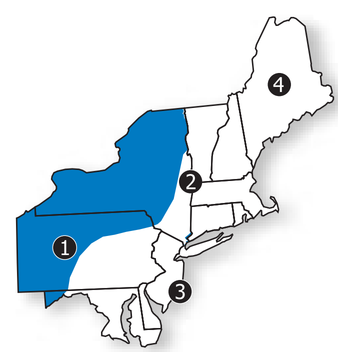
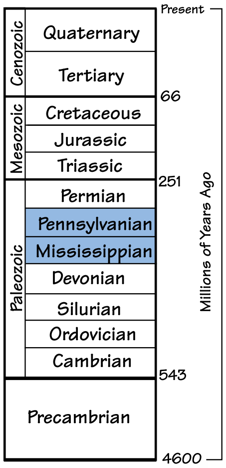


Figure 4.13: Tentaculites *lower Devonian (2 cm).*





Plants can be tricky to reconstruct because their parts (wood, leaves, seeds) tend to break apart and are found separately. Usually each plant part gets its own Latin name. Careful analysis may enable putting a species back together, but there have been many cases in which several plant parts assumed to belong to very different groups of plants turned out to be the same species.

see Non-Mineral Resources, p.156, for more on the formation of **coal.**

Mississippian and Pennsylvanian

Pennsylvania preserves one of the best-known Pennsylvanian-age plant communities in the world *(Figures 4.14-4.17)*. Large amounts of sediment were being rapidly eroded from the Acadian Mountains to the east, quickly burying plant material in coastal floodplain environments and creating oxygen-poor conditions that prevented the decomposition of organic matter. Plant and other non-marine fossils from the Mississippian and the early Permian are also present in Pennsylvania, but are far less extensive. Common Mississippian and Pennsylvanian plants include horsetails, ferns, seed ferns, and scale trees. These plants formed extensive forests in swampy areas along the edge of the inland ocean that led to the formation of coal deposits found in Pennsylvania and Maryland. Plants are not the only fossils recorded in the Pennsylvanian and Mississippian rocks of the Inland Basin, as the inland ocean still existed in much of the basin at this time. The plant fossils represent typical ferns, seed ferns, and horsetails, while the marine fossils represent typical Inland Basin brachiopods, cephalopods, clams, corals, and snails.

Pennsylvanian-age horsetails reached over 30 meters high. Their stems are known as Calamites *and their leaves are called* Annularia. *The modern horsetail equivalents are known as sphenopsids (Figure 4.14).*

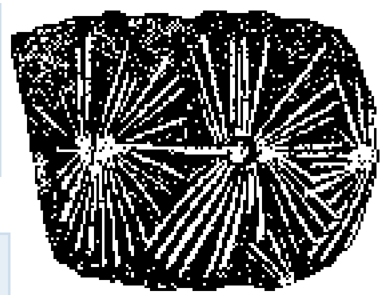


Figure 4.14: Annularia *leaf, Pennsylvanian (specimen 9.5 cm wide).*

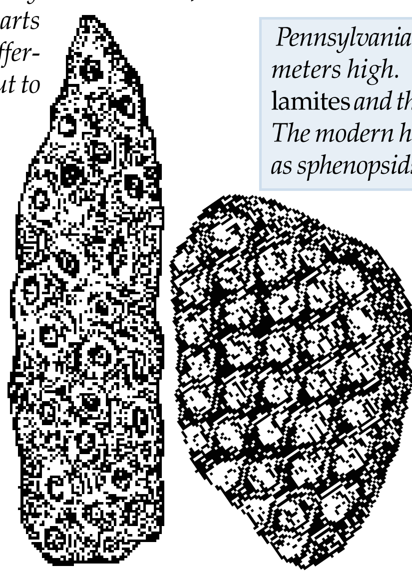


Figure 4.15: LEFT ABOVE: Plant root, Stigmaria, *Pennsylvanian (14 cm long); RIGHT: Lycopod* Lepidodendron, *bark with leaf scars, Pennsylvanian (10.5 cm wide).*

Scale trees (lycopsids) grew up to 45 meters high in Mississippian and Pennsylvanian forests. The roots of a scale tree are called Stigmaria. *The entire tree is known as* Lepidodendron. *The modern scale tree equivalents are known as lubmosses or ground pines (Figure 4.15).*

Seed ferns (pteridosperms) lived from the Mississippian to the Jurassic. The leaves (Neuropteris) *resemble ferns, but have seeds instead of spores (Figures 4.16 and 4.17).*

Figure 4.16: Seed fern plant, Neuropteris, *Pennsylvanian (5.5 cm long).*

Figure 4.17: Seed fern plant, Alethopteris, *Pennsylvanian (8 cm long).*