I'm not a bot

 Pteridophytes are commonly known as ferns and fern allies. The word pteridophyte derived from Greek words pteron and python meaning feather and plant respectively. Pteridophytes occupies the transitional space between bryophytes and spermatophytes. There are about 12,000 species of pteridophytes. Pteridophytes are the first terrestrial plants having vascular bundles and reproduce using spores. They thrive in most and shady regions except some species living in rocky slopes and sandy regions.Photo by Olena Sergienko on UnsplashECOLOGICAL ROLES OF PTERIDOPHYTESPteridium species are ecological indicators of burnt and disturbed forest.Equisetum arvense and E.plebjum are indicators of gold in soil. And Asperniuum adulternum is a natural indicator of nickel. Actinopteris australis is an indicator of cobalt.Pteridophyte create and habitat for small organisms like millipods, arthropods, their larvae and bacteria, cyanobacteria.Provides shelter for eggs of frogs and fishes.Prevents soil erosion and slow degradation of the gametophytic plant will prevent soil from excessive leaching. Pteris vittata is an excellent arsenic hyper accumulator, hence reducing contamination hence is used to purify water in area with high arsenic contamination.ECONOMIC USES OF PTERIDOPHYTESSporocarp of marsilea are eaten by different tibal groups.The croziers of Matteuccia struthipteris are canned and served as spring veggie in Canada and USA.croziers of MetteucciaLeaves of Marsilea, commonly known as 'sushni' is widely used as vegetable.a dish made up of sushniRhizome of pteris that is rich in starch is used as food.The young fronds of Ampelopteris polifera are sold in the markets as 'Dhekhi shaak' in India and Bangladesh.dekhi shaak vaja2) AS FODDERThe corn of isoetes are used as food for pigs, ducks, and other animals.he quadrified lamina of Marsilea has been used as fodder for ducks.Dry fronds of many ferns a re used as fodder for many animals.Azolla is widely used as fodder in various farms.azolla as foddercorn of isoetes3) SCOURINGEquisetum stems have been used in scouring and polishing metals.Hence Equisetum species are used for scouring.Equisetum stem4)BIOFERTILIZERThe relationship between alga and azolla is symbiotic where alga provide nitrogen to plants. Thus azolla in full bloom in the water provides fixed nitrogen to surrounding plants too.azollaThus alga serves as green manure in water logged rice fields.5) AS MEDICINESpores of Lycopodium is used as protective dusting powder for tender skin. Medicine from Lycopodium are used as stomachic and diuretic.Lycopodium powderAn oil from Aspidium is used as a vermifuge especially for tapeworm.The decoction of Asplenium are used for cough and a good hair wash.The expectorant of polypodium is used as mild laxative while the tonic is used for dyspepsia and hepatic problems.aspidium oilPolypodiumThe chemically active principal 'marsaline' isolated from Marsilea is found to be very effective against sedative and anti-canvulant principal.Preparation of Ophioglossum valgatum as green oil charityis also used for wounds.Ophiglossum6) HORTICULTUREMany species are cultivated for aesthetic value. Many variants of Psilotum have been brought in cultivation in nurseries and with 'whisk fern'.Microsorium, Nephrolepis etc. have aesthetic value for their shape, leaves several arrangement hence they are highly cultivated. Some lycopodium species are grown on hanging.Ferns used as ornamentalsGarden7) Azolla — A water fernAzolla is an aquatic fern present in tropical and temperate region.It posses cavity under leaves for Anabaena alga that is capable for nitrogen fixation. It can either grown with rice field as an intercrop or included in field before planting rice.They can retrieve a low concentration of heavy metals from the surrounding medium but Azolla filiculoides absorbs a large concentration.Azolla is regarded as a feasible , sustainable method to separate pollutants from the waste-water.Azolla is also used for weed control, insect and mosquito control.Used in hydrogen and biogas production and Used in biodiesel production and as a space diet.Azolla in full bloom8)SalvineaKnown as water moss.Seen in tropical places like Mexico, West indies, Africa, north America, And certain parts of Asia.Salvinia auriculata's dense colonies can completely cause habit degradation this species is listed to be invasive in Cuba, Chile, Taiwan, Zimbabwe, Zambia.S.molesta has been introduced as an ornamental plant and has been used as a mulch crop in dry area.Used for weed control, mosquito and also as fodderDue to invasive nature of salvinia a special beetle is introduced to kill it called Crytobagous salviniaePteridophytes has a variety of uses in both ecological and economic terms. Thank you for reading my article. views updated Jun 11 2018Pteridophtyes are a phylum of plants. They are the vascular plants (those having xylem and phloem tissues) that reproduce by releasing spores rather than seeds, and they include the highly diverse true ferns and other graceful, primarily forest-dwelling plants. There are about eleven thousand different species of pteridophytes, making them the most diverse land plants after the flowering plants (angiosperms). Pteridophytes may represent the closest living relatives (sister group) to the seed plants. (Seed plants include the angiosperms, the conifers, and a smaller assortment of other plants.)As in seed plants, the greatest diversity of pteridophytes is found in the tropics, with only about six hundred species adapted for life in temperate climates. Species living today are relics of ancient lineages that once dominated the land surface. There is a rich fossil record showing that pteridophytes have ancestors dating back nearly four hundred million years. Before there were seed plants, there were pteridophytes such as large, treelike (up to 36.5 meters [120 feet] tall) Lepidodendron, an ancestor of modern club mosses (which are no more than .30 meter [1 foot] tall), and shrubby Sphenophyllum, a forebear of today's horsetails. Some of the ancient predecessors of modern ferns were also preserved, but there are comparatively few fossils for interpreting relationships among the approximately eleven thousand species of true ferns. These relatively young species probably arose along with the other most recent lineages of vascular plants, the angiosperms or flowering plants, another group lacking an extensive fossil record.Pteridophytes range greatly in size. There are tiny floating ferns used as "green fertilizer" in rice paddies because they partner with bacteria that pull nitrogen from the air and "fix" it in chemical compounds that other plants can use. In some tropical forests, the largest plants are tree ferns that can be up to 30 meters (100 feet) tall and have huge spreading leaves up to 4.5 meters (15 feet) in length. Pteridophytes also show a transition from simple to complex leaves. Some pteridophyte groups, including the club mosses and horsetails (classes Lycopodiopsida and Equisetopsida), have simple microphyllous leaves, featuring a single, unbranched vein and modest vascular supplies that do not cause breaks or gaps in the stem vasculature. The true ferns (class Filicopsida), however, have larger, more complex macrophyllous leaves whose veins are usually extensively branched, placing such large demands on the plant's vasculature that distinctive gaps form in the xylem and phloem of the stem.CLASSIFICATION OF THE PTERIDOPHYTESPhylum PteridophytaClass LycopodiopsidaOrder Lycopodiales, the club mosses* and ground pines, approximately 400 speciesOrder Selaginellales, the spike mosses*, approximately 450 speciesOrder Isoetales, the quillworts, approximately 130 speciesClass Equisetopsida, the horsetails or scouring rushes*, 15 speciesClass Psilotopsida, the wisk ferns, approximately 12 speciesClass Filicopsida, the true ferns, approximately 10,000 species* The common names "mosses" and "rushes" applied to these species do not mean that these groups are related to the mosses and rushes, any more than a pineapple is related to pines or a breadfruit has some affinity to wheat. True mosses are nonvascular plants whose most commonly recognized life form is a gametophyte, and true rushes are grasslike flowering plants. Instead, these common names indicate that the club "mosses" and spike "mosses" are often small plants that hug the ground, and scouring "rushes" have long, grasslike stems.All pteridophytes have a true alternation of generations, in which a dominant sporophyte generation produces spores through meiosis , and a free-living gametophyte generation forms gametes (egg and sperm) by mitosis . Ferns can be used to illustrate the life cycle stages common to all pteridophytes. Diploid (2n) fern sporophytes are familiar to most people and are often found as quiet accompaniments in floral arrangements. When mature, the undersides of fern leaves produce clusters of capsular structures called sporangia, within which meiosis forms the haploid (n) spores. These spores are released from the sporangia, often when dry wind currents cause the active snapping of the capsules, lofting the spores into the air.Spores that are wind-borne to shady, moist habitats germinate and yield multicellular, but microscopic, gametophytes, the sexual stage of the life cycle. These short-lived, delicate plants mature and produce egg-forming archegonia and sperm-producing antheridia. When water is present, multi-flagellated sperm swim from mature antheridia, are chemically attracted to the necks of the archegonia, and fertilize the eggs. Although frequently bisexual (hermaphroditic), in most cases the sperm produced by a gametophyte cannot successfully fertilize its own eggs and must swim to archegonia on neighboring, genetically different gametophytes. The diploid zygotes , produced by the fusion of haploid egg and sperm, divide mitotically and differentiate into mature sporophytes, completing the life cycle.Although most pteridophytes are homosporous (produce spores that are all the same size), a few groups are heterosporous with large megaspores and small microspores. The megaspores produce megagametophytes that only form eggs, and microspores only produce microgametophytes and sperm. Heterospory evolved independently in several groups of vascular plants, including all members of the orders Selaginellales and Isoëtales and those in a few fern groups (the families Marsileaceae and Salviniaceae of the class Filicopsida). The most successful origin of heterospory ultimately resulted in the great diversity of seed plants.No pteridophytes are cultivated as crop plants, but the leaf buds ("fiddleheads") of some ferns are commercially harvested and canned or frozen. Fern leaves used in floral arrangements are a major industry in Florida, and in some cultures tree fern stems are used to make elegant, naturally sculpted bowls. The contrasting colors of the vascular tissue in the stems and leaf bases of these plants create complex and pleasing designs. In the past, club moss spores provided the powder used to coat rubber gloves and prophylactics, and photographers used masses of these same spores as flash powder, since they could be easily and quickly ignited.see also Alternation of Generations; Angiosperms; Bryophytes; Nitrogen Fixation; Plant; Reproduction in Plants; Seedless Vascular PlantsChristopher HauflerBibliographyJones, David. Encyclopaedia of Ferns. Melbourne, Australia: Lothian Publishing Co., 1987.Raven, Peter H., Ray F. Evert, and Susan E. Eichhorn. Biology of Plants, 6th ed. New York: W. H. Freeman and Company, 1999.Tyron, Rolla, and Alice Tyron. Ferns and Allied Plants. New York: Springer-Verlag, 1982. views updated May 08 2018pteridophytes See PTERIDOPHYTA. views updated May 21 2018pteridophytes See PTERIDOPHYTA. This is a question and answer forum for students, teachers and general visitors for exchanging articles, answers and notes. Answer Now and help others. Answer Now Here's how it works: Anybody can ask a question Anybody can answer The best answers are voted up and rise to the top Normally, when we talk about plants we refer to those vascular plants that can reproduce by seeds, but there are other plants without seeds but that are also vascular, it is the pteridophyta division . Pteridophytes are a group of plants of great importance in the life of human beings for about 400 million years.In this AgroCorrn article we will find out more about pteridophyte plants, what they are, their types and examples .What are pteridophyte plants – definitionTypes of pteridophyte plantsPteridophyte plants: examplesPteridophytes are perennial vascular plants , without secondary growth and that do not generate seeds during their life cycles, but reproduce by means of spores . Spores are defined as unicellular or multicellular microscopic bodies formed with the objective of allowing long-term dispersal and survival. The spores manage to germinate and develop very well in climates with high humidity.They are also known as vascular cryptogams or ferns and are quite primitive plants. They grow and develop in tropical climates (where they reach palm tree growth), temperate (with more herbaceous growth), humid or even some in arid areas. In addition, there are some aquatic or semi-aquatic subspecies, although none develop in salty waters.By having conductive fabrics, which also serve as support, they manage to rise several meters above the ground. These tissues also help it to better capture light and therefore can photosynthesize very completely. Ferns are believed to have been the first plants to adapt to living outside of water, although their life cycles are highly dependent on water.The greatest importance of this group of plants is that they are often used both for human consumption and for their decorative and ornamental effects, such as ferns and young plants; If you have these plants at home, you may be interested in learning about the cultivation and care of ferns at home . In addition, some specimens are used for medicinal or therapeutic purposes, such as horsetail.The vast majority of the public only knows ferns, but there are many more types. The most important types of pteridophyte plants are:HorsetailsThey are popularly known by the name of horsetail. They have an underground rhizome from which a large number of aerial clippings emerge. The leaves and stems of horsetails are hollow and easy to determine with respect to their fossil relatives, since they have characteristic ridges that differentiate them from other subspecies.Club mosses and SelaginellasThis variety of pteridophytes has branched stems with simple leaves and is characterized by producing two types of spores: microspores and megaspores.PsilophytesThis type of pteridophytes is somewhat different from other types, since it has an underground stem, but the plant does not generate roots. Another characteristic of these pteridophytes is that their leaves are so small that one might think that they do not have them. Psilophytes are closely related to a type of fossil plant of vascular origin, called Rhynia .IsoetesIt is a genus of pteridophyte plants that are aquatic or semi-aquatic. The Isoetes have leaves with a hole in the middle and that are quite narrow. They usually grow and develop on wet land, streams, lakes or rivers, but never in salty sea water. For this reason, they live mainly in jungles and forests.FernsFerns are the best known and most widely used type of pteridophyte plants. More than 12,000 species of ferns are known in the world. These inhabit humid ecosystems and feed on humid air and the water that runs down their stem. Ferns are the pteridophytes that thrive the fastest and even develop above other plants, being able to grow up to 5 meters in length.Learn more about them in this other AgroCorrn article about Ferns are plants without flowers or seeds .Some examples of pteridophyte plants are:HorsetailsHorsetail or common horsetail (Equisetum arvense): the most common horsetail of all. Widely used for its medicinal properties.Horsetail (Equisetum palustre): it often causes poisoning, given its palustrin content, and it can be confused with the common horsetail.Greater horsetail (Equisetum telmateia): sometimes used instead of the common horsetail, for its diuretic properties.Equisetum hyemale: toxic species up to 1.5 m. and very little branched.Equisetum ramossimum: toxic species due to palustrin. It does not have leaves.Equisetum giganteum : horsetail up to 5 m tall. It is used in the southern hemisphere.Club mosses and SelaginellasLycopodium clavatum : a very cosmopolitan and common species, also in Spain.Lycopodium obscurum: species native to the United States. Common in temperate coniferous and deciduous forests.Lycopodium annotinum: common herbaceous species in coniferous forests in the Northern Hemisphere.Selaginella nickname : lycophyte native to the eastern United States and northwestern MexicoPsilophytesIn this case there are few species and the following stand out:Psilotum complanatum.Psilotum naked.IsoetesIsoetes lacustris : it is distributed in northern regions of America and Europe.Isoetes durieui: perennial plant with a short underground stem. It can be found in the Mediterranean, as in Andalusia, where it is declared a vulnerable species.FernsBlecno (Blechnum humps).Elk horn (Platycerium bifurcatum).Deer tongue (Phyllintis scolopendrium).Culantrillo (Agropyron).The bird's nest (Begonia nests).If you want to read more articles similar to Pteridophytes plants: what they are, types and examples , we recommend that you enter our Biology category . Taxationincome tax assessment levied upon individual or corporate incomes. Pathologyautism , developmental disability resulting from a neurological disorder that affects the normal functioning of the brain. BuddhismPure Land Buddhism or Amidism, devotional sect of Mahayana Buddhism in China and Japan, centering on worship of the Buddha Amitabha. U.S. HistoryBoston Tea Party 1773. Explorers, Travelers, and Conquerors: BiographiesHernán Cortés or Hernando Cortez , 1485-1547, Spanish conquistador , conqueror of Mexico. French and Benelux Physical GeographyPyrenees , Span. Pirineos, Fr. environmentalism surrogate mother education martial arts Barcelona Economic Importance The Economic importance of Pteridophyte is given in Table 2.4 Rumohra adiantiformis (leather leaf fern) : Cut flower arrangements. Marsilea : Food Azolla : Biofertilizer. Dryopteris filix–mas : Treatment for tapeworm. Pteris vittata : Removal of heavy metals from soils - BioremediationPteridium sp. : Leaves yield green dye. Equisetum sp. : Stems for scouring. Psilotum, Lycopodium, Selaginella, Angiopteris, Marattia : Ornamental plants Page 2Selaginella Division – Lycophyta Class – Ligulopsida Order – Selaginellales Family –Selaginellaceae Genus – Selaginella Selaginella is commonly called 'spike moss'. They are distributed in humid temperate and tropical rain forests. Selaginella rupestris and Selaginella lepidophylla are Xerophytic. Selaginella kraussiana, Selaginella chrysocaulos, Selaginella megaphylla are some common species. In few Selaginella species during dry season the entire plant body gets curled and become fresh, green when moisture is available. Due to this they are called Resurrection plants. Example S. lepidophylla External morphology Habit The plant body of Selaginella is sporophyte (2n) and it is differentiated into root, stem, and leaves (Figure 2.25). There exist variations in the habit of Selaginella. Some species possess prostrate creeping system (S. kraussiana); suberect (S. rupestris); erect (Selaginella erythropus); Climbing (Selaginella alligans). S. oregana is an epiphyte. Most of the species are perennials. on the basis of structure of stem and arrangement of leaves, Selaginella is divided into two sub genera namely Homoeophyllum and Heterophyllum. Homeophyllum include species with erect stem and spirally arranged leaves. (Example: S. upestris and S. oregana). Heterophyllum include species with prosrate stem with short erect branches and dimorphic leaves (Example: S. kraussiana and S. lepidophylla). Root Primary roots are short lived and the adult plant has adventitious roots. The root may arise at the point of dichotomous branching or knot like swelling present at the basal portion of the stem. Roots are endogenous in origin. Rhizophore In many species long, cylindrical, unbranched and leafless structures arise from the lower side of the stem at the point of dichotomy called rhizophores. They grow vertically downwards and produce tufts of adventitious roots. Stem The stem may be erect, dichotomously branched or prostrate with lateral branching. The prostrate stem is dorsiventral. Leaves The leaves are microphyllous, sessile and simple. A single midvein is present in the leaves. The vegetative leaf as well as the sporophyll bears a small membranous tongue like structure on adaxial surface called ligule. The basal part of the ligule possess a hemispherical mass of thin walled cells called glossopodium. The function of ligule is not known, but it is viewed to be associated with water absorption, secretion and prevent dessication of shoot. The members belonging to Homeophyllum type possess same type of leaves spirally arranged on the stem whereas the Heterophyllum type have two types of leaves- two dorsal rows of small leaves(Microphylls) and two ventral rows of large leaves(Megaphylls). Internal structure Root The transverse section of the root reveals an outermost layer called epidermis. It is made up of tangentially elongated cells. The cortex is homogeneous made up of thin walled parenchyma . The innermost layer of cortex is called endodermis. The stele is a protostele, monarch and xylem is exarch (Figure 2.26). Rhizophore The outermost layer of Rhizophore is the epidermis. It is single layered and is covered with a thick cuticle. The cortex is differentiated into outer scelrenchymatous and inner parenchymatous layers. The innermost layer of cortex forms endodermis. The stele is a protostele Figure 2.27. It is monarch and exarch but it is centrifugal in S. kraussiana and crescent shaped in S. atroviridis. Stem The anatomy of the stem reveals the presence of epidermis, cortex and stelar region (Figure 2.28). The epidermis is parenchymatous and is covered with a thick cuticle. The cortex is parenchymatous with cells arranged without intercellular spaces. A sclerenchymatous hypodermis is noticed in Selaginella lepidophylla. The presence of radially elongated endodermal cell s called trabeculae is the characteristic feature of Selaginella. The casparian strips are found on the lateral walls. The rapid stretching of the innermost cortical cells in comparison with stele results in air spaces and stele appears to be suspended in air space with the help of trabeculae. The stele is a protostele and exarch. A variation in number of steles is found. It may be monostelic (S. spinulosa); distelic (S. kraussiana)or polystelic (S. laevigata). The xylem is monarch(S. kraussiana) or diarch (S. oregana) . Tracheids are present but vessels are also noticed in S. densa and S. rupestris. Leaf The leaf shows upper and lower epidermis. The epidermal cells have chloroplast. Stomata occur on both surfaces. The mesophyll is made up of loosely arranged thin walled cells with intercellular spaces. There is a median vascular bundle surrounded by a bundle sheath. In vascular bundle xylem is surrounded by phloem. Reproduction Selaginella shows both vegetative and asexual modes of reproduction. Vegetative reproduction Selaginella reproduces vegetatively by fragmentation, bulbil formation, tuber formation and resting buds. Sexual reproduction During sexual reproduction spores are produced (Figure 2.29). Selaginella is heterosporous and produces two types of spores namely microspores in microsporangium and megaspores in megasporangium. The sporangia are borne singly in the axils of microsporophyll and megasporophyll respectively. The sporophylls are arranged spirally around a central axis and aggregate to form strobili or cones. Variations in the distribution of microsporangia and megasporangia among the species are seen. In S. selaginoides and S. rupestris megasporangia are present in the basal part of the cone. S. kraussiana possesses a single megasporangium at the base of the strobilus. In S. inaequifolia one side of the strobilus bear only megasporangia and other microsporangia. Separate strobili for microsporangia and megasporangia are present in S. gracilis. and S. atro-viridis.The development of sporangium is of eusporangiate type. The sporangial initial divides periclinally to form outer jacket initials and inner archesporial initials. The archesporial initials by repeated anticlinal and periclinal divisions form sporogenous cells. Microspore mother cells of microsporangiumundergoreductiondivision to produce halpoid microspores. Similarly the megaspore mother cell undergoes reduction division to produce 4 haploid megaspores. The microspore and megaspore represent the male and female gametophyte and germinate inside the sporangium. The microspores produce biflagellate antherozoids. Archegonia develop in the megaspore. The antherozoids swim in water and reach the archegonium. Fertilization brings the fusion of male and female nucleus which result in the formation of a diploid zygote. The diploid zygote represents the first cell of sporophyte.It undergoes several mitotic division to form embryo. The embryo develops into a mature sporophytic plant.In the life cycle of Selaginella alternation of sporophytic and gametophytic generation is present (Figure 2.30). (i) Psilopsida (Psilotum)(ii) Lycopsida (Selaginella, Lycopodium)(iii) Sphenopsida (Equisetum)(iv) Pteropsida (Dryopteris, Pteris, Adiantum). Note:- Azola is an aquatic water fern used as bio fertilizer. The alga Anabaena fixes atmospheric nitrogen in symbiotic with Azolla. Home » Botany Notes » Archegoniate » Pteridophyta – Characteristics, Classification, Origin, Ecological and economic importancePteridophyta, commonly known as pteridophytes, are a group of vascular plants that reproduce via spores instead of seeds or flowers. As non-flowering plants, they are sometimes referred to as "vascular cryptogams," meaning their reproductive structures are hidden. This group includes ferns, horsetails, and lycophytes (like clubmosses, spikemosses, and quillworts). Though historically classified as "Pteridophyta," this term is no longer widely accepted since ferns and horsetails are more closely related to seed plants than lycophytes. However, the study of these plants remains significant, and terms like pteridophyte, pteridology, and pteridologist are still commonly used in scientific communities.The name "Pteridophyta" is derived from the Greek words "pteron," meaning feather, and "phyton," meaning plant, which refers to their feather-like fronds. Pteridophytes are some of the earliest vascular plants on Earth, with a rich history that dates back around 400 million years to the Silurian period of the Paleozoic era. These plants thrived during the Devonian period and played a dominant role in Earth's vegetation from the Devonian to the Permian periods. Fossil evidence of pteridophytes has been found in rocks from the Silurian and Devonian periods, highlighting their long-standing presence on the planet.One of the most distinctive features of pteridophytes is their well-developed vascular system, consisting of xylem and phloem, which allows for efficient water and nutrient transport throughout the plant. This adaptation enabled them to colonize land environments effectively. Pteridophytes are considered the first true land plants, making them an important subject for understanding plant evolution and the adaptations that facilitated terrestrial life.The life cycle of pteridophytes involves an alternation of generations, with two distinct phases: the gametophyte and sporophyte. Unlike bryophytes, where the gametophyte is the dominant phase, in pteridophytes, the sporophyte is the predominant generation. The sporophyte, being more robust and better suited to terrestrial environments, allows the plant to thrive in land habitats. The gametophyte, on the other hand, is typically smaller and shorter-lived.With around 12,000 species of pteridophytes existing today, these plants remain a diverse and ecologically important group. Though they no longer dominate Earth's vegetation as they once did during the Paleozoic era, their evolutionary significance and role in understanding plant adaptations to land continue to make them a focus of botanical research.Pteridophytes are an ancient group of vascular plants known for their distinctive features and diverse forms. They primarily thrive in moist, shaded environments, although some adapt to aquatic or xerophytic conditions. Here are the key characteristics of pteridophytes, focusing on their morphology, structure, and reproductive processes:Habitat Preferences:Most pteridophytes are terrestrial, preferring cool, moist, and shaded areas, as seen in ferns.Some species are aquatic, such as Marsileci and Azolla, while others can survive in dry, xerophytic conditions (Selaginella rupestris, Equisetum).A few species are epiphytic, like Lycopodium squarrosum, growing on other plants.Growth Forms:Pteridophytes are predominantly herbaceous. However, certain species, such as Angiopteris, are perennial and can grow into tree-like forms.The size range varies, with the smallest pteridophyte being Azolla (an aquatic fern) and the largest being the tree fern Cyathea.Sporophytic Plant Body:The dominant phase of the plant body is the sporophyte, which is well-differentiated into roots, stems, and leaves.The roots are adventitious and can exhibit monopodial or dichotomous branching. Internally, the roots often have a diarch structure.Stem Characteristics:Stems in pteridophytes are typically branched, with either monopodial or dichotomous branching patterns.Branches do not arise from the axils of the leaves, and in many species, the stem is represented by a rhizome.Leaf Morphology:Leaves can vary widely in size and form. They may be small and scaly (microphyllous), as in Equisetum, or large and pinnately compound (megaphyllous), as seen in Dryopteris and Adiantum.Microphyllous leaves do not form leaf gaps in the vascular supply, while megaphyllous leaves do.Vascular Tissue:The vascular system, consisting of xylem and phloem, is present in both the stems and roots.Xylem contains only tracheids, while the phloem lacks companion cells and true sieve tubes, instead having sieve cells.The stele type varies, including protostele (e.g., Rhynia, Lycopodium), siphonostele (e.g., Equisetum), dictyostele (e.g., Adiantum), and polycyclic (e.g., Angiopteris).Secondary growth does not occur because cambium is absent.Reproduction and Spore Formation:Reproduction involves the formation of meiospores through sporic meiosis within sporangia.Leaves that bear sporangia are termed sporophylls.Most pteridophytes are homosporous, producing only one type of spore (e.g., Pteris, Adiantum). However, some are heterosporous, generating two different spore types: microspores and megaspores (e.g., Selaginella, Salvinia, Marsilea).Gametophyte and Sexual Reproduction:The gametophyte stage is small and usually independent of the sporophyte.Both male and female sex organs are multicellular and protected by a cell layer. Antheridia are small and sessile, while archegonia are partially embedded with a 4-rowed neck.The sperm cells are bi-flagellate or multi-flagellate, requiring water for movement to the archegonia for fertilization.Embryo and Life Cycle:An embryo stage is present in the life cycle.Pteridophytes exhibit heteromorphic alternation of generations, where the sporophyte is the dominant generation, while the gametophyte is comparatively short-lived and less prominent.Habitat of PteridophytesPteridophytes, being the first vascular plants to adapt to life on land, are primarily found in tropical and temperate zones. Although most thrive in terrestrial environments, they have adapted to a wide range of habitats. Below is a detailed overview of the various habitats in which pteridophytes can be found:Terrestrial Habitats:The majority of pteridophytes, from ancient fossils to modern species, inhabit terrestrial environments. These plants typically prefer moist, shaded areas.Examples of species found in terrestrial habitats include Ophioglossum sp., Lycopodium clavatum, Lycopodium cernum, and Equisetum sp.Some species demonstrate unique adaptability. For instance, Equisetum debile can grow in hydrophytic, mesophytic, and xerophytic environments, showing a remarkable range of tolerance.Other species exhibit more specific habitat preferences, such as Equisetum palustre, which thrives in swampy areas, and Equisetum arvense, which is commonly found in open grasslands.Aquatic Habitats:A subset of pteridophytes, primarily from the families Marsileaceae and Salviniaceae, have adapted to aquatic or semi-aquatic environments. These are commonly referred to as aquatic ferns.Common species in this category include Marsilea minuta and Marsilea quadrifolia, which are frequently found in water or wetlands.Xerophytic Habitats:Some species of the genus Selaginella are adapted to survive in dry, arid conditions. These xerophytic pteridophytes have evolved to endure harsh environments with limited water availability.Examples of xerophytic species include Selaginella wightii, Selaginella repanda, and Selaginella lepidophylla.Origin of PteridophytesThe origin of pteridophytes dates back to the Silurian period, with significant diversification occurring during the Lower Devonian. The evolutionary history of pteridophytes is a subject of debate, with two primary theories proposed: one positing an algal origin and the other suggesting that pteridophytes evolved from bryophytes. Each theory presents distinct evolutionary pathways and evidence, making the topic complex yet intriguing for researchers.Algal Origin:Some scientists propose that pteridophytes originated from algae, although there is no consensus regarding the exact type of ancestral algae. This theory is based on similarities between algae, especially those in the Chlorophyceae class, and pteridophytes. These common features include:Thalloid gametophytes.Photosynthetic pigments such as chlorophyll a and b, as well as carotenoids.Cell walls composed of cellulose.Starch as the storage form of food.Flagellated sperms.The necessity of water for fertilization.Phragmoplast formation during cytokinesis, involving a complex network of microtubules and membrane vesicles.Lignier's Hypothesis (1908):Lignier suggested that pteridophytes evolved from Chlorophyta, with a dichotomizing parenchymatous thallus. He theorized that the transition from aquatic to terrestrial habitats involved the basal part of the plant entering the soil for anchorage and absorption. The erect parts remained photosynthetic, forming a primitive branching system, as seen in Rhynia.Church's Hypothesis (1919):Church proposed a polyphyletic origin of pteridophytes, suggesting that advanced marine seaweeds called Thallasiophyta were the ancestors of both bryophytes and pteridophytes. He theorized that marine planktonic algae became benthic after the upheaval of ocean floors, leading to the formation of Thallasiophyta. The adaptation to terrestrial life then led to the development of land plants with roots, leaves, and vascular systems. However, this hypothesis lacks geological support and faces criticism due to differences in pigmentation between marine algae and early land plants.Fritsch's Hypothesis (1916, 1945):Fritsch believed that pteridophytes and bryophytes evolved from a common Chaetophoraceous green algae ancestor. He proposed that heterotrichous algae, with both prostrate and upright systems, gave rise to erect land plants by enhancing the upright portion and reducing the prostrate part.Andrews' Hypothesis (1950, 1959):Andrews theorized that fossil marine algae such as Nematothallus, Protosalvinia, and Crocelophyton independently gave rise to various groups of early vascular plants. He cited the morphological diversity in Psilopsida, Lycopsida, Sphenopsida, and Pteropsida as supporting evidence for this polyphyletic origin.Mehra's Hypothesis (1969):Mehra proposed that both bryophytes and pteridophytes originated from a hypothetical Proto-archegoniate group, which in turn arose from Chaetophoraceous ancestors. This group led to the evolution of both the Psilophytaceous line and the Lycopodiaceous line.Bryophytic Origin:The theory of bryophytic origin of pteridophytes is based on the similarities between early vascular plants and the sporophytes of certain mosses and hornworts. Shared characteristics include:Heteromorphic life cycle.Multicellular sex organs.Motile and flagellated sperms.Thalloid gametophytes.Water dependence for fertilization.Retention of the zygote within the female sex organ and development of the embryo.Plant and spore surfaces covered by cutin (cuticle).Anthocerotean Theory:Proposed by Campbell (1895), this theory argues that the sporophyte of Anthoceros shares many features with early vascular plants, such as rhizoids instead of roots, meristematic tissue for indefinite growth, columella, photosynthetic tissues with stomata, and limited tissue for spore production. Smith (1955) supported this hypothesis, suggesting that the meristematic region shifted from the base to the apex, allowing the dichotomy seen in early vascular plants.Strobilar Theory:Bower (1894, 1908) posited that pteridophytes evolved from an Anthoceros-like ancestor, with progressive sterilization of sporogenous tissues leading to the formation of well-differentiated sporophytes, as seen in Lycopodium selago. The evolution involved sporogenous tissue becoming superficial, dividing into separate masses, and eventually developing leaves with sporangia at their base.Phyton Theory:Celekovsky (1901) proposed that the fundamental part of the sporophyte was originally a leaf, with the axis forming later by the fusion of leaf bases.Protocorm Theory:Treub (1890) hypothesized that the primitive pteridophyte sporophyte resembled a protocorm, an undifferentiated mass. He supported this theory by pointing to the protocorm found in some species of Lycopodium, suggesting that it represented an early transitional stage in the evolution of the sporophyte.Modern Interpretation:Recent molecular and biochemical studies, including the analysis of 5S/16S rRNA sequences and molecular data from plastid, nuclear, and mitochondrial genes, suggest that bryophytes are not the direct ancestors of vascular plants. Instead, both bryophytes and pteridophytes likely evolved from green algal ancestors, possibly from Coleochaete, which is closely related to charophytes. Coleochaete is considered a model for the algal ancestor of land plants, possessing features such as zygote retention, phragmoplast cell division, and lignin presence, which align with those of land plants.Classification of PteridophytesThe classification of Pteridophytes represents a critical area of study in plant taxonomy, encompassing a diverse group of vascular plants commonly known for their absence of seeds. Historically, the term "Pteridophyta" was first introduced by Haeckel, leading to a series of systematic classifications that have evolved significantly over time due to advances in paleobotany and botanical research.Classification of PteridophytesHistorical Classifications:Eichler (1883) divided the plant kingdom into two major categories: Cryptogamia (non-seed plants) and Phanerogamia (seed plants). Within Cryptogamia, Pteridophytes were classified along with Thallophyta and Bryophyta.Engler (1909) subsequently placed both Bryophyta and Pteridophyta under the umbrella of Embryophyta.Evolution of Classification:The classification of Pteridophytes has undergone significant changes due to the discovery of fossil plants, particularly seed-bearing forms like Cycadofilicales. This led to the recognition that older taxonomic divisions separating Pteridophyta (seedless vascular plants) from Spermatophyta (seed-bearing plants) were insufficient.In light of these developments, Sinnott (1935) introduced the term Tracheophyta to describe a division characterized by sporophytes with well-developed vascular tissues.Nomenclatural Standards:The International Code of Botanical Nomenclature (I.C.B.N. 1952) established specific suffix conventions for plant classifications, recommending that division names end with "-phyta," sub-division names with "-phytina," and class names with "-opsida."Modern Classifications:Wardlaw (1955) categorized Pteridophytes into four main divisions based on structural and functional traits:Psilopsida: Encompasses both living (e.g., Psilotum) and fossil plants (e.g., Rhynia). These plants exhibit a simple structure, characterized by the absence of roots, with a body organization comprising a subterranean rhizome and an erect aerial shoot bearing homosporous sporangia.Lycopsida: This division includes both living (e.g., Lycopodium, Selaginella) and fossil forms (e.g., Lepidodendron). Members possess roots, stems, and microphyllous leaves, with sporangia developing on the adaxial surfaces of sporophylls, and can be classified as homosporous or heterosporous.Sphenopsida: This division comprises living species like Equisetum and fossil plants such as Calamophyton. They typically feature long, jointed stems with whorled leaves, and sporangia located at the apex of fertile branches, primarily exhibiting homospory, although some fossil forms are heterosporous.Pteropsida: Commonly known as ferns, this division includes approximately 300 genera and over 10,000 species. They thrive in diverse habitats and display a variety of morphological traits, such as large fronds and the presence of sori on leaves, which can be homosporous or heterosporous.Comprehensive Taxonomic Structures:Various taxonomists have contributed to the modern understanding of Pteridophyte classification, with significant contributions from Smith (1955) and Bold (1957). The most accepted structure is:Division I: PsilophytaClass: PsilotopsidaClass: PsilopsidaDivision II: LycophytaClass: EligulopsidaClass: LigulopsidaOrders: Selaginellales, Lepidodendronales, Isoetales, PleuromealesDivision III: Sphenophyta or CalamophytaClass: SphenophyllopsidaClass: CalamopsidaOrders: Calamitales, Hyeniales, EquisetalesDivision IV: Pterophyta (Ferns)Class: PrimofilicopsidaOrders: Cladoxyales, CoenopteridalesClass: EusporangiopsidaOrders: Ophioglossales, MarattialesClass: ProtoleptosporangiopsidaClass: LeptosporangiopsidaOrders: Filicales, Marsileales, SalvinealesClassification of PteridophytesReproduction of pteridophytesReproduction in pteridophytes is a complex process characterized by both vegetative and sexual methods. The primary mode of reproduction in these plants involves the production of spores, yet vegetative reproduction also plays a significant role in their life cycle.Vegetative Reproduction:Pteridophytes can reproduce vegetatively through several mechanisms:Formation of Gemmae or Bulbils: Many pteridophytes can form bulbils or gemmae, which are leafy side branches with a broad base that develop into new sporophytes. When these gemmae fall to the ground, they can germinate and grow into young plants. Examples include Psilotum, Lycopodium phlegmaria, and L. selago. Certain species of Selaginella also propagate using bulbils.Fragmentation: This method occurs when older regions of the stem die and decay, leading to the formation of new branches. These branches can develop into separate plants, a common practice among species such as Lycopodium, Selaginella, Dryopteris, Pteris, and Adiantum.Formation of Tubers: Tubers may arise from parenchymatous regions of the shoot and root. Surface tubers form at the ground surface, while underground tubers develop below ground. These tubers consist of cells rich in stored food and possess the capacity to germinate into new plants. Some species of Marsilea, Lycopodium renulosum, and Equisetum form such tubers.Formation of Adventitious Buds: Adventitious buds can be induced on isolated bulbil leaves or as a result of decapitating the stem near its apex. Species of Lycopodium and Selaginella may develop these buds. In Dryopteris, such buds arise in the leaf axils, detaching to form new plants. Additionally, in certain cases, such as Asplenium esculentum and platycerium, the root apex may develop directly into a leafy bud capable of growing into a new plant.Asexual Reproduction:The predominant mode of reproduction in pteridophytes is asexual reproduction through haploid spores, which are produced in structures called sporangia. These sporangia may develop either on the ventral surface or within the axils of leaves, with the leaves bearing sporangia referred to as sporophylls. In the Psilophytales, sporangia are found caulinarily, whereas, in some fossil pteridophytes, such as Rhynia, they appear terminal on fine aerial branches. In genera like Azolla, Marsilea, and Salvinia, sporangia are contained within specialized structures called sporocarps, while in higher ferns, sporangia group into organized structures known as sori (singular: sorus).According to Goebel's classification from 1881, sporangia can be categorized into two types:Eusporangiate: These develop from a group of initial cells.Leptosporangiate: These arise from a single initial cell.Sporophyte Generation:The sporophyte, the spore-producing body of pteridophytes, is the dominant and most conspicuous phase in their life cycle. Unlike bryophytes, where the gametophytic phase predominates, pteridophytes exhibit a free-living alternation between sporophytic (asexual) and gametophytic (sexual) generations. Although both generations are independent, the sporophyte typically attains a much greater size than the gametophyte.Pteridophytes may exhibit two basic types of life cycles:Homosporous: These pteridophytes produce only one type of spore, typically leading to the development of a hermaphroditic (monoecious) gametophyte.Heterosporous: In contrast, heterosporous pteridophytes generate two kinds of spores—larger megaspores and smaller microspores—leading to the formation of female and male gametophytes, respectively. Heterosporous pteridophytes include species like Selaginella, Isoetes, Marsilea, Salvinia, and Azolla, while homosporous cycles are observed in genera such as Psilotum, Tmesipteris, Lycopodium, Equisetum, and various homosporous Filicopsids.Gametophyte Generation:The gametophyte represents the sexual phase in the life cycle of pteridophytes. The haploid spores serve as units of the gametophyte, germinating to form a structure known as a prothallus. Typically, prothalli are green, simple, and somewhat branched; however, in some genera such as Lycopodium, they can be subterranean, branched, colorless, and saprophytic.Both antheridia (male sex organs) and archegonia (female sex organs) develop on the prothallus. Generally, homosporous pteridophytes produce monoecious prothalli, while heterosporous pteridophytes typically exhibit dioecious prothalli. Antheridia, surrounded by a jacket layer, produce antherozoids, which are unicellular and can be either uniciliate or multiciliate depending on the species. Archegonia consists of a projecting neck and a lower embedded venter containing the egg cell.Fertilization and Zygote Formation:Fertilization occurs in the presence of water, which facilitates the movement of antherozoids. As a film of water forms between the prothallus and the substratum, cap cells of the antheridia open to release the antherozoids. These are attracted to the archegonia by malic acid released from a mucilaginous mass, allowing them to swim toward the archegonia. Typically, only one antherozoid fuses with an egg cell within the archegonium, resulting in the formation of a diploid zygote, often following cross-fertilization due to the protandrous nature of the prothalli.Embryo Development:The zygote undergoes development into an embryo, with the first division generally occurring transversely. Subsequent divisions lead to the formation of a young sporophyte, marking the transition from the gametophyte generation back to the dominant sporophyte phase of the life cycle.Alternation of Generation in pteridophytesPteridophytes, a diverse group of vascular plants, exhibit a true alternation of generations, a life cycle involving both a multicellular haploid stage (gametophyte) and a multicellular diploid stage (sporophyte). This process highlights the distinct reproductive strategies that facilitate survival and adaptation. The sporophyte generation is dominant and produces spores through meiosis, while the gametophyte generation forms gametes by mitosis, showcasing the intricate interplay between these two stages.Alternation of Generation in pteridophytesSporophyte Generation:The mature sporophyte is diploid, possessing two sets of chromosomes (2n).It produces haploid spores (n) through the process of meiosis, which reduces the chromosome number by half.These spores are vital for the continuation of the life cycle as they germinate and develop into gametophytes.Gametophyte Generation:The resulting gametophyte is haploid, containing one set of chromosomes (n).It matures and produces gametes (sperm and eggs) through mitosis, maintaining the haploid chromosome number.When two gametes fuse during fertilization, a diploid zygote forms, which eventually develops into a new sporophyte.Cycle of Alternation:The sporophyte and gametophyte stages alternate sequentially in the life cycle of pteridophytes.This pattern, termed "alternation of generations," is an essential survival strategy, allowing pteridophytes to switch between sexual and asexual reproduction as environmental conditions change.Abnormalities in the Life Cycle:While the alternation of generations is typically consistent, it can be disrupted by phenomena known as apogamy and apospory.Apogamy:This phenomenon involves the development of a sporophyte directly from a gametophyte without any sexual fusion (syngamy).The resulting sporophyte retains the haploid chromosome number characteristic of the gametophyte (n).Apogamy was first identified by Farlow in 1874 in the species Pteris cretica and is prevalent among various ferns, including Pteris, Pteridium, Dryopteris, Adiantum, Osmunda, Todea, Athyrium, and Asplenium.Apospory:Apospory refers to the development of gametophytes from vegetative cells of the sporophyte, bypassing meiotic division and the formation of spores.This results in gametophytes that are diploid, a deviation from the typical haploid gametophyte.The term was first introduced by Druery in 1884, following his observations in Athyrium filix-femina. Subsequently, apospory has been documented in several pteridophytes, such as Pteridium aquilinum, Asplenium dimorphum, Osmunda regalis, and Todea.The life cycle of pteridophytesThe life cycle of pteridophytes is characterized by a fascinating alternation between two generations: the sporophyte (2n) and the gametophyte (n). This process typically involves a periodic doubling of the chromosome number through syngamy (fertilization), followed by a halving through meiosis. However, deviations from this standard reproductive cycle are observed in some pteridophyte species, highlighting the diversity of reproductive strategies within this group.Pteridophyte life cycleSporophyte Generation (2n):The dominant generation in pteridophytes is the sporophyte, which is typically diploid.It produces spores through meiosis in specialized structures called sporangia.These spores are haploid (n) and can develop into the gametophyte generation.Gametophyte Generation (n):The gametophyte is a free-living, haploid stage that arises from the germination of spores.It produces gametes (sperm and eggs) through mitosis in structures known as gametangia.The fusion of gametes during syngamy leads to the formation of a new diploid sporophyte.Variations in Reproductive Strategies:Parthenogenesis: In certain ferns, such as Marsilea, Cyathea, and Athyrium, the embryo can develop from an unfertilized egg. This phenomenon, known as parthenogenesis or "virgin birth," allows for reproduction without the need for fertilization.Apospory:Apospory occurs when gametophytes develop directly from vegetative cells of the sporophyte, bypassing the haploid spore stage entirely.In this case, cytological studies have revealed that the resulting gametes are diploid. Consequently, when these gametes fuse, the resulting sporophyte is tetraploid, as seen in species like Osmunda regalis and Pteris vittata.Apogamy:Apogamy is another deviation wherein a sporophyte forms without fertilization, arising from the vegetative cells of the gametophyte.The chromosome number of the apogamous sporophyte is determined by that of the gametophyte, which can be either haploid or diploid. Examples include ferns such as Pteridium, Cheilanthes, and Pteris.Stelar System in PteridophytesThe stelar system in pteridophytes is a vital aspect of their anatomy and function, serving as a fundamental component of their vascular systems. The term "stele" is derived from the Greek word meaning "column" or "pillar," reflecting its role as a central structural element. The concept of the stele as the primary unit of vascular organization was first proposed by van Tieghem and Douliot in 1886, who identified the stele as a central cylinder surrounded by the cortex, with the endodermis serving as the anatomical boundary between these two regions. This central cylinder typically comprises various vascular tissues, including xylem, phloem, pericycle, and sometimes pith or medullary rays.Formation and Types of Steles: In lycopsids, such as Lycopodium and Selaginella, the development of the stele occurs independently from the leaf traces, resulting in a cauline primary vascular system. The leaf traces in these plants are generally small and connected superficially to the vascular cylinder. In contrast, the stelar anatomy in ferns like Pteridium and Pteris is influenced by larger leaf traces and leaf gaps, leading to a composite structure that incorporates both cauline and foliar vascular components.Classification of Steles: Researchers have identified two principal types of stelar organization in pteridophytes: Protostele and Siphonostele.Protostele: Characterized by the absence of a central pith, protosteles are considered the most primitive form of stelar organization. They consist of a central strand of primary xylem surrounded by a cylinder of phloem. Protosteles are found in early vascular plants such as Rhynia, Horneophyton, and living representatives like Psilotum and Selaginella. Various forms of protostele include:Haplostele: A simple, solid core of xylem surrounded by phloem, seen in plants such as Tmesipteris and Selaginella.Actinostele: Features a lobed, star-shaped xylem core with phloem situated in groups between the lobes, found in species like Psilotum.Plectostele: Characterized by xylem breaking into several parallel plates, each encircled by phloem, seen in Lycopodium species.Mixed Protostele: Displays small groups of tracheids embedded in phloem, observed in Lycopodium cernuum.Siphonostele: This stele features a central column of parenchymatous pith, representing an advancement over protostele. In siphonosteles, the vascular tissues are arranged in a cylindrical fashion, with distinct pith at the center. Siphonostele can be classified into two main types based on phloem positioning:Ectophloic Siphonostele: Contains a single ring of phloem external to the xylem core, as seen in Equisetum and Osmunda.Amphiphloic Siphonostele: Features phloem surrounding the xylem on both sides, with two endodermal layers, observed in ferns like Marsilea and Dryopteris.Further Classifications of Siphonosteles: Siphonosteles can also be divided based on the presence or absence of leaf and branch traces:Cladosiphonic: Characterized by the absence of leaf traces, found in lycopsids.Phyllosiphonic: Features both leaf and branch traces, as seen in members of the order Filicales.Evolutionary Aspects of Siphonostele: Based on the arrangement of leaf gaps, siphonosteles can be categorized into:Solenostele: Exhibits non-overlapping leaf gaps, with only one break in the vascular cylinder at any given point.Dictyostele: Characterized by overlapping leaf gaps, resulting in a highly dissected vascular structure, commonly found in ferns where the rhizome is compacted with leaves.Polycyclic Stele: A complex form of siphonostele with multiple concentric vascular cylinders, observed in species like Pteridium aquilinum and Montania peotinata. This type can further be classified into polycyclic solenosteles and polycyclic dictyosteles based on the outer cylinder's characteristics.Economic Importance of PteridophytesPteridophytes, often overlooked in discussions about economic plants, hold significant importance across various sectors, particularly in food, medicine, horticulture, and environmental applications. Despite their limited documentation, the diverse uses of pteridophytes contribute to human welfare in several meaningful ways.Pteridophytes Used as Food:Young leaf tips of ferns, known as circinate ptyxis or croziers, are consumed as vegetables.For example, the young fronds of Ampelopteris prolifera are marketed as 'dheki shaak' in India and Bangladesh.Canned or frozen croziers of Matteuccia struthiopteris are enjoyed as spring vegetables in the USA and Canada.Additionally, the leaves of Marsilea, commonly referred to as 'shushni', serve as a vegetable.The rhizomes of many ferns, such as Pteris, are rich in starch and are utilized as food.The corms of Isoetes are also used as food for pigs, ducks, and other animals.Pteridophytes Used as Fodder:Dry fronds of various ferns provide livestock feed.The quadrifid lamina of Marsilea, which resembles clover (Trifolium), is utilized as animal fodder, serving as a substitute for traditional clover.Pteridophytes Used as Medicine:The spores of Lycopodium are extensively used in the pharmaceutical industry as protective dusting powder and water-repellents for sensitive skin.The foliage of Lycopodium is prepared as tinctures, powders, ointments, and creams for various medicinal purposes, including as a stomachic and diuretic.Decoctions of Lycopodium are applied in homeopathy to treat conditions such as diarrhea, bladder irritability, eczema, rheumatism, constipation, and liver inflammation.Equisetum is noted for its high content of silicic acid and silicates, alongside potassium, aluminum, manganese, and flavonoids, which contribute to its diuretic and connective tissue-strengthening properties.Several ferns serve as herbal remedies; for instance, oil extracted from the rhizome of Aspidium is used as a vermifuge, particularly against tapeworms.Decoctions from Asplenium are employed for cough relief, while extracts from Polypodium act as mild laxatives.The root decoction of Osmunda regalis is traditionally used for treating jaundice, and its root is applied topically to wounds.Additionally, the extraction of Osmanda vulgaris, known as 'Green oil charity', is effective for wound treatment.Pteridophytes Used as Horticultural Plants:Many species of pteridophytes are cultivated for their aesthetic appeal.For instance, variants of Psilotum are commonly grown in nurseries and greenhouses as 'whisk fern'.Epiphytic species of Lycopodium, such as L. phlegmaria and L. lucidulum, are prized for their aesthetic value and are suitable for hanging baskets.Various species of Selaginella serve as ground cover, while the decorative qualities of species like Salaginella willdenovii and S. uncinata attract gardeners for their striking blue color.Ferns like Angiopteris, Asplenium, Marattia, Microsorium, and Nephrolepis are valued for their graceful shapes and beautiful soral arrangements.Pteridophytes Used as Biofertilizers:Azolla, a rapidly multiplying water fern, plays a crucial role in agriculture.It houses live colonies of the nitrogen-fixing cyanobacterium Anabaena azollae, creating a symbiotic relationship where the alga supplies nitrogen to the plant.Farmers utilize Azolla as a green manure in rice paddies, enhancing crop production.Pteridophytes Used as Indicator Plants:Certain pteridophytes serve as indicator plants for mineral deposits.For example, Equisetum can accumulate minerals, including gold, at rates up to 4.5 ounces per ton, making it a valuable resource in the search for gold ore deposits.Other species, such as Asplenium adulterinum and Actinopteris australis, indicate the presence of

nickel and cobalt, respectively.Pteridophytes Used for Various Purposes:Pteridophytes have a range of applications beyond food and medicine.The stem of Equisetum has historical use for polishing wood and cleaning utensils.Roots and stems of Osmunda are utilized in making orchid beds.Water boiled with Lycopodium clavatum is used for dyeing wool, providing a blue hue when treated with Brazil wood.Lycopodium powder is also highly flammable, making it useful in pyrotechnics and artificial lighting demonstrations.Ecological Importance of PteridophytesPteridophytes, commonly known as ferns and their allies, play a vital role in ecosystems due to their unique characteristics and adaptability. Their ecological importance can be outlined as follows:Habitat Formation:Pteridophytes often thrive in diverse habitats, ranging from tropical rainforests to temperate woodlands and even arid regions. They contribute significantly to habitat structure, providing shelter and nesting sites for various organisms.Soil Stabilization:The extensive root systems of pteridophytes help prevent soil erosion, especially on slopes and in areas prone to landslides. Their ability to form dense mats of foliage can stabilize soil, maintaining soil quality and preventing loss of topsoil.Biodiversity Support:Pteridophytes contribute to biodiversity by offering habitats for numerous species, including insects, amphibians, and small mammals. They serve as a food source for herbivorous animals and as a substrate for various microorganisms.Nutrient Cycling:These plants are essential in nutrient cycling. As pteridophytes grow and die, they decompose, enriching the soil with organic matter and nutrients. This process enhances soil fertility, supporting a diverse range of plant species.Water Regulation:Pteridophytes play a crucial role in the water cycle. They can absorb and retain moisture in their leaves and surrounding soil, contributing to local humidity levels and influencing microclimates. Their transpiration helps maintain water balance in ecosystems.Medicinal Uses:Many pteridophytes have been utilized in traditional medicine for their therapeutic properties. Their bioactive compounds are being researched for potential applications in pharmaceuticals, highlighting their value beyond ecological contributions.Carbon Sequestration:By capturing carbon dioxide during photosynthesis, pteridophytes contribute to carbon sequestration, playing a role in mitigating climate change. Their capacity to store carbon in their biomass aids in reducing greenhouse gas concentrations in the atmosphere.Cultural and Aesthetic Value:In many cultures, pteridophytes are valued for their aesthetic appeal and are commonly used in landscaping and gardening. Their presence can enhance the beauty of natural environments, promoting ecotourism and conservation efforts. //www.geeksforgeeks.org/pteridophytes/ //www.biologydiscussion.com/pteridophytes/classification-pteridophytes/classification-of-pteridophytes-botany/52998 //www.jsscacs.edu.in/sites/default/files/Department%20Files/AN-%20HC%201.2-%20PTERIDOPHYTES_compressed%20%282%29_compressed.pdf Pan. (2024, October 7). Pteridophyta – Characteristics, Classification, Origin, Ecological and economic importance. Biology Notes Online. Retrieved from Pan. "Pteridophyta – Characteristics, Classification, Origin, Ecological and economic importance." Biology Notes Online, 7 October 2024, biologynotesonline.com/pteridophyta-characteristics-classification-origin-ecological-and-economic-importance/.Sourav Pan. "Pteridophyta – Characteristics, Classification, Origin, Ecological and economic importance." Biology Notes Online (blog). October 7, 2024. . Economic Importance The Economic importance of Pteridophyte is given in Table 2.4 Rumohra adiantiformis (leather leaf fern) : Cut flower arrangements. Marsilea : Food Azolla : Biofertilizer. Dryopteris filix–mas : Treatment for tapeworm. Pteris vittata : Removal of heavy metals from soils - BioremediationPteridium sp. : Leaves yield green dye. Equisetum sp. : Stems for scouring. Psilotum, Lycopodium, Selaginella, Angiopteris, Marattia : Ornamental plants Page 2Selaginella Division – Lycophyta Class – Ligulopsida Order – Selaginellales Family –Selaginellaceae Genus – Selaginella Selaginella is commonly called ‘spike moss’. They are distributed in humid temperate and tropical rain forests. Selaginella rupestris and Selaginella lepidophylla are Xerophytic. Selaginella kraussiana, Selaginella chrysocaulos, Selaginella megaphylla are some common species. In few Selaginella species during dry season the entire plant body gets curled and become fresh, green when moisture is available. Due to this they are called Resurrection plants. Example S. lepidophylla External morphology Habit The plant body of Selaginella is sporophyte (2n) and it is differentiated into root, stem, and leaves (Figure 2.25). There exist variations in the habit of Selaginella. Some species possess prostrate creeping system (S. kraussiana); suberect (S. rupestris); erect (Selaginella erythropus); Climbing (Selaginella alligans). S. oregana is an epiphyte. Most of the species are perennials. on the basis of structure of stem and arrangement of leaves, Selaginella is divided into two sub genera namely Homoeophyllum and Heterophyllum. Homeophyllum include species with erect stem and spirally arranged leaves. (Example: S. upestris and S. oregana). Heterophyllum include species with prosrate stem with short erect branches and dimorphic leaves (Example: S. kraussiana and S. lepidophylla). Root Primary roots are short lived and the adult plant has adventitious roots. The root may arise at the point of dichotomous branching or knot like swelling present at the basal portion of the stem. Roots are endogenous in origin. Rhizophore In many species long, cylindrical, unbranched and leafless structures arise from the lower side of the stem at the point of dichotomy called rhizophores. They grow vertically downwards and produce tufts of adventitious roots. Stem The stem may be erect, dichotomously branched or prostrate with lateral branching. The prostrate stem is dorsiventral. Leaves The leaves are microphyllous, sessile and simple. A single midvein is present in the leaves. The vegetative leaf as well as the sporophyll bears a small membranous tongue like structure on adaxial surface called ligule. The basal part of the ligule possess a hemispherical mass of thin walled cells called glossopodium. The function of ligule is not known, but it is viewed to be associated with water absorption, secretion and prevent dessication of shoot. The members belonging to Homeophyllum type possess same type of leaves spirally arranged on the stem whereas the Heterophyllum type have two types of leaves- two dorsal rows of small leaves(Microphylls) and two ventral rows of large leaves(Megaphylls). Internal structure Root The transverse section of the root reveals an outermost layer called epidermis. It is made up of tangentially elongated cells. The cortex is homogeneous made up of thin walled parenchyma . The innermost layer of cortex is called endodermis. The stele is a protostele, monarch and xylem is exarch (Figure 2.26). Rhizophore The outermost layer of Rhizophore is the epidermis. It is single layered and is covered with a thick cuticle. The cortex is differentiated into outer scelrenchymatous and inner parenchymatous layers. The innermost layer of cortex forms endodermis. The stele is a protostele Figure 2.27. It is monarch and exarch but it is centrifugal in S. kraussiana and crescent shaped in S. atroviridis. Stem The anatomy of the stem reveals the presence of epidermis, cortex and stelar region (Figure 2.28). The epidermis is parenchymatous and is covered with a thick cuticle. The cortex is parenchymatous with cells arranged without intercellular spaces. A sclerenchymatous hypodermis is noticed in Selaginella lepidophylla. The presence of radially elongated endodermal cell s called trabeculae is the characteristic feature of Selaginella. The casparian strips are found on the lateral walls. The rapid stretching of the innermost cortical cells in comparison with stele results in air spaces and stele appears to be suspended in air space with the help of trabeculae. The stele is a protostele and exarch. A variation in number of steles is found. It may be monostelic (S. spinulosa); distelic (S. kraussiana)or polystelic (S. laevigata). The xylem is monarch(S. kraussiana) or diarch (S. oregana) . Tracheids are present but vessels are also noticed in S. densa and S. rupestris. Leaf The leaf shows upper and lower epidermis. The epidermal cells have chloroplast. Stomata occur on both surfaces. The mesophyll is made up of loosely arranged thin walled cells with intercellular spaces. There is a median vascular bundle surrounded by a bundle sheath. In vascular bundle xylem is surrounded by phloem. Reproduction Selaginella shows both vegetative and asexual modes of reproduction. Vegetative reproduction Selaginella reproduces vegetatively by fragmentation, bulbil formation, tuber formation and resting buds. Sexual reproduction During sexual reproduction spores are produced (Figure 2.29). Selaginella is heterosporous and produces two types of spores namely microspores in microsporangium and megaspores in megasporangium. The sporangia are borne singly in the axils of microsporophyll and megasporophyll respectively. The sporophylls are arranged spirally around a central axis and aggregate to form strobili or cones. Variations in the distribution of microsporangia and megasporangia among the species are seen. In S. selaginoides and S. rupestris megasporangia are present in the basal part of the cone. S. kraussiana possesses a single megasporangium at the base of the strobilus. In S. inaequifolia one side of the strobilus bear only megasporangia and other microsporangia. Separate strobili for microsporangia and megasporangia are present in S. gracilis. and S. atro-viridis.The development of sporangium is of eusporangiate type. The sporangial initial divides periclinally to form outer jacket initials and inner archesporial initials. The archesporial initials by repeated anticlinal and periclinal divisions form sporogenous cells. Microspore mother cells of microsporangiumundergoreductiondivision to produce halpoid microspores. Similarly the megaspore mother cell undergoes reduction division to produce 4 haploid megaspores. The microspore and megaspore represent the male and female gametophyte and germinate inside the sporangium. The microspores produce biflagellate antherozoids. Archegonia develop in the megaspore. The antherozoids swim in water and reach the archegonium. Fertilization brings the fusion of male and female nucleus which result in the formation of a diploid zygote. The diploid zygote represents the first cell of sporophyte.It undergoes several mitotic division to form embryo. The embryo develops into a mature sporophytic plant.In the life cycle of Selaginella alternation of sporophytic and gametophytic generation is present (Figure 2.30).