SIES College of Arts, Science & Commerce (Empowered Autonomous)
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November 2024 | Volume 7 | Issue 1

GULMOHAR

"Gulmohar Newsletter"

Department of Botany

"Exploring the Past to Preserve the Future"

FROM THE EDITOR'S DESK

Selvamathi Kamaraj Nadar
T.Y.B.Sc

Welcome to the new edition of the Gulmohar Newsletter for the year 2024-25. In this edition, we have put up some fascinating articles and photographs.

In this edition, we have an article about ,
"Exploring the past to preserve the future"
in this topic we have included about the 'plant evolution, climatic changes in fossil plants, Paleoecology, Paleobotany and conservation, careers in Paleobotany, exam alerts...
finally, yet importantly, we have some fun facts and a photo gallery to showcase the photography skills of the students.

Happy Reading!!

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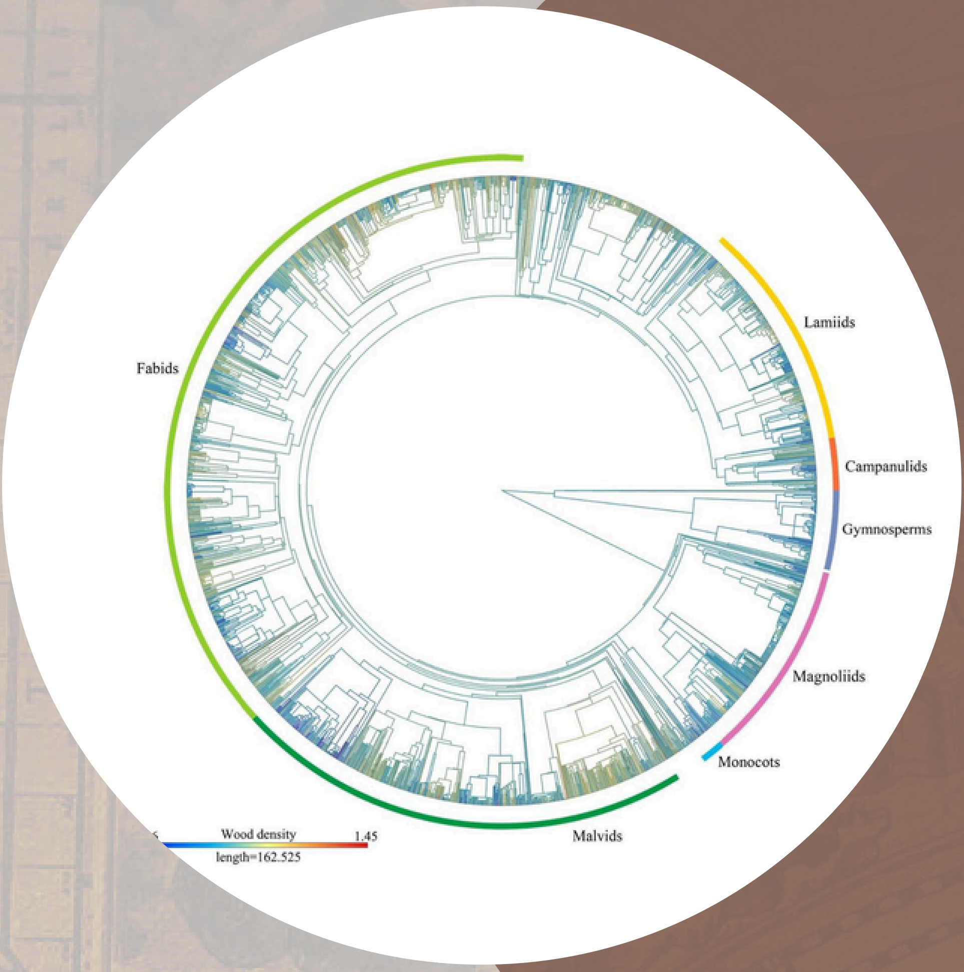
PLANT EVOLUTION



1. Evolutionary History shapes variation of Wood Density of tree species across the World

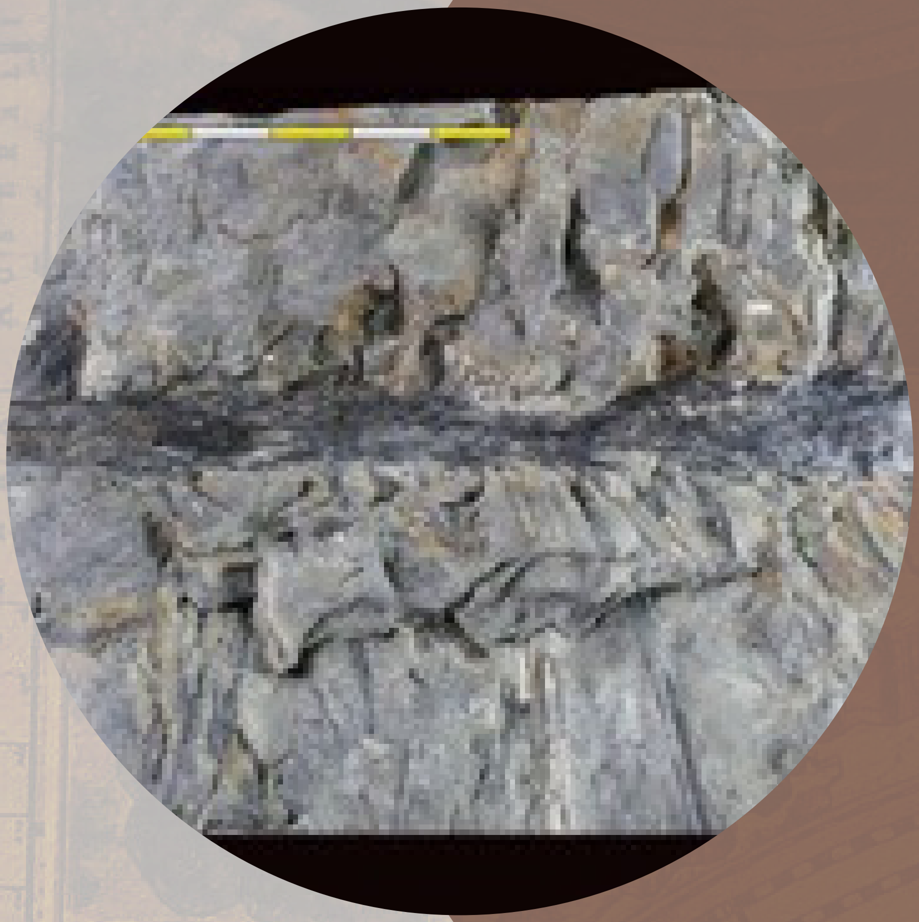
Investigations to date have largely ignored this aspect, how phylogenetic history has assumed power to wood density variation in the temporal context. To evaluate the assumption that evolution throughout the history of the group affects the variation in wood density among tree species, we use a large dataset consisting of 27,297 wood density measurements from 2621 tree species across the globe.

In different taxonomic (angiosperms and gymnosperms) and ecological (tropic, temperate, and boreal) clusters of tree species we tested the phylogenetic signal, followed by mapping the biogeographical and evolutionary history of wood density and assessed contemporary factors like climate and soil factors and evolution such as phylogeny in global wood density. Such a trend is quite more pronounced since wood density exhibited a rather high phylogenetic signal. It was clear that wood density was not uniform over the different biomes and climatic zones, and notably, higher mean values of wood density were found in more arid climates (most pronounced values recorded in the subtropical desert).

Our study demonstrated that over the entire globe focusing both in angiosperms and gymnosperms phylogeny, species which are different units representing the variation attributed to taxonomy and not referencing the variation explained by long term evolutionary history and hence displayed the wood density was an important phylogenetic signal.

-Lynn

PLANT EVOLUTION



2. Rare Tree Fossils preserved with Leaves unlike any Plant known today

An earthquake 350 million years ago toppled the trees and entombed them in a mud bath, leaving near-perfect imprints of their trunks and leaves in sediments at the bottom of what was then a lake. In 2017 geologists met the first fossil of a tree during their work in a quarry located in New Brunswick, where they have during successive years excavated 4 more almost identical specimens. Typically, it is only the main trunk that can be conserved in prehistoric remains. However, the latest find suggests a thicket of more than 250 leaves surrounding the top 75 centimeters of a thin un-branched tree trunk approximately 2.7 meters erect. According to the current research, the leaves reached even 3 meters in length and developed thickly spiral outgrowths which were 1.5 meters off the trunk.

The trees, named Sanfordiacaulis, likely evolved this spiral layout to maximize the amount of sunlight the leaves captured for photosynthesis, the researchers wrote in the study. Their shorter stature also suggests these plants are the earliest example of smaller trees growing beneath the canopy of taller trees. The reconstruction of these plants "distorts our sense of how trees are organized and grow". "Their growth architecture is similar to, but distinctly different from, two tree models found in today's tropics," including a small number of tree ferns, gymnosperms (plants with exposed seeds) and flowering plants, he said. But these modern plants carry fewer leaves in their crowns – between 15 and 20 in the case of tree ferns and palm trees.

-Lynn

PLANT EVOLUTION

3. 390 million-year-old fossilized forest is the oldest ever discovered

The fossils in southwest England are 4 million years older than the Gilboa fossil forest. This means that they represent the earliest known forest on Earth.
The fossils in southwest England were found to be older than those in Gilboa, which suggests that forests evolved more rapidly than previously thought.

This is supported by the fact that the two ecosystems are quite different, indicating that forests became more complex and diverse over a relatively short period of time. While the Gilboa forest showcased a diverse array of ancient plants, the newly discovered forest appears to have been dominated by a single species. This stark difference highlights how quickly plant ecosystems could become more complex and diverse during the early stages of their development.

Cladoxylopsids were ancient plants that resembled palm trees but were actually more closely related to ferns and horsetails. Despite their appearance, they lacked true leaves and instead had a structure composed of numerous small twigs.

-Lynn

Climate Changes in Fossil Plants

Introduction:

Fossil plants provide invaluable insights into the Earth's climate history. These remnants of ancient flora, preserved in rock layers over millions of years, act as natural archives that record past climatic conditions. By examining these plant fossils, scientists can better understand how the Earth's climate has changed over geological time scales and predict future climate changes.

1. Fossil Plants as Climate Indicators: Fossil plants, such as leaves, wood, pollen, and spores, are key indicators of past climate. They provide clues about temperature, precipitation, and atmospheric conditions in different periods. For example, the size and shape of leaves can indicate the temperature and humidity of the environment in which they grew. Broad, large leaves with smooth edges suggest warm, wet climates, while smaller leaves with serrated edges indicate cooler, drier conditions.

2. Analyzing Plant Fossils to Understand Past Climates: Scientists use various methods to analyze plant fossils, such as examining growth rings in fossilized wood or studying the chemical composition of fossilized leaves. One common technique is the study of stomata, the tiny pores on leaves that regulate gas exchange. Stomatal density, the number of stomata per unit area, can indicate the levels of carbon dioxide (CO2) in the atmosphere. High stomatal density suggests lower atmospheric CO2 levels, while low density indicates higher levels, helping scientists understand ancient greenhouse gas concentrations.

3. Case Studies of Climate Change Inferred from Fossil Plants:
Paleocene-Eocene Thermal Maximum (PETM):
About 56 million years ago, a rapid warming event known as the Paleocene-Eocene Thermal Maximum (PETM) occurred. Fossil plants from this period show significant changes in species composition, indicating a shift to more heat-tolerant species. Analysis of plant fossils also suggests increased atmospheric CO2 levels, likely caused by massive releases of carbon from volcanic activity or methane hydrate dissociation.Ice Age Climate Cycles:
During the Ice Ages, plant fossils found in various regions provide evidence of shifts between glacial and interglacial periods. Fossilized pollen from trees such as spruce and pine found in sediments indicates colder periods, while pollen from broadleaf trees like oak and maple points to warmer interglacial phases.

-Shrivasugi

Climate Changes in Fossil Plants

4. Implications for Current and Future Climate Change: Studying fossil plants is not just about understanding the past; it also provides valuable lessons for the future. By understanding how plants responded to past climate changes, scientists can predict how modern ecosystems may react to ongoing global warming. For instance, understanding how plant distributions shifted during previous warm periods can help forecast future changes in vegetation patterns.

5. Challenges and Limitations: While fossil plants offer crucial insights, there are challenges in interpreting data from them. The fossil record is often incomplete, and the preservation of plant material can be influenced by various factors, such as burial conditions and geological processes. Additionally, the interpretation of data can be complicated by the fact that plants respond to multiple environmental factors, not just climate alone.

Conclusion:

Fossil plants are a powerful tool for understanding the Earth's climatic past and can provide essential clues about how our planet's climate system works. By examining the evidence preserved in these ancient plant remains, scientists can better predict the impacts of current and future climate changes. Despite the challenges, ongoing research in paleobotany and climatology continues to uncover the complex relationships between plants and climate, offering new insights into the Earth's dynamic environment.

It's a geologically short period, and during that period, starting about 56 million years ago, the climate warmed by something like five, six degrees Celsius, which,would be a 10 degrees Fahrenheit, 11 degrees Fahrenheit in a period of just a few thousand years. And then it stayed warm for probably about 100,000 to 120,000 years following that and then it dropped back down to the temperature it had been before that, but of course, this is all during a time period when it's already quite warm. So it's basically a short, really warm interval in the middle of a much longer also very warm interval.leaves of different species look different in detail when you really zoom in and look at those veins carefully. And then there are also features of the edge of the leafthe smooth leaves and the toothed leaves. Those features can be really informative as well.

-Shrivasugi

Climate Changes in Fossil Plants

If we have an assortment of fossil leaves from one place, we can get an idea of what the temperature was from the proportion of species with smooth edgesBy comparing fossil plants with their modern-day relatives We can deduce what type of climate the plants were living in. For example, palm trees today are exclusively tropical or subtropical plants. So, the duo can infer that a fossilized palm likely grew in a warm climate. Roughly 56 million years ago, during a time called the Paleocene Eocene Thermal Maximum (PETM), Earth's average temperature rose four to eight degrees Celsius in less than 10,000 years. The cause was geologic processes releasing trillions of tons of carbon dioxide into the atmosphere.

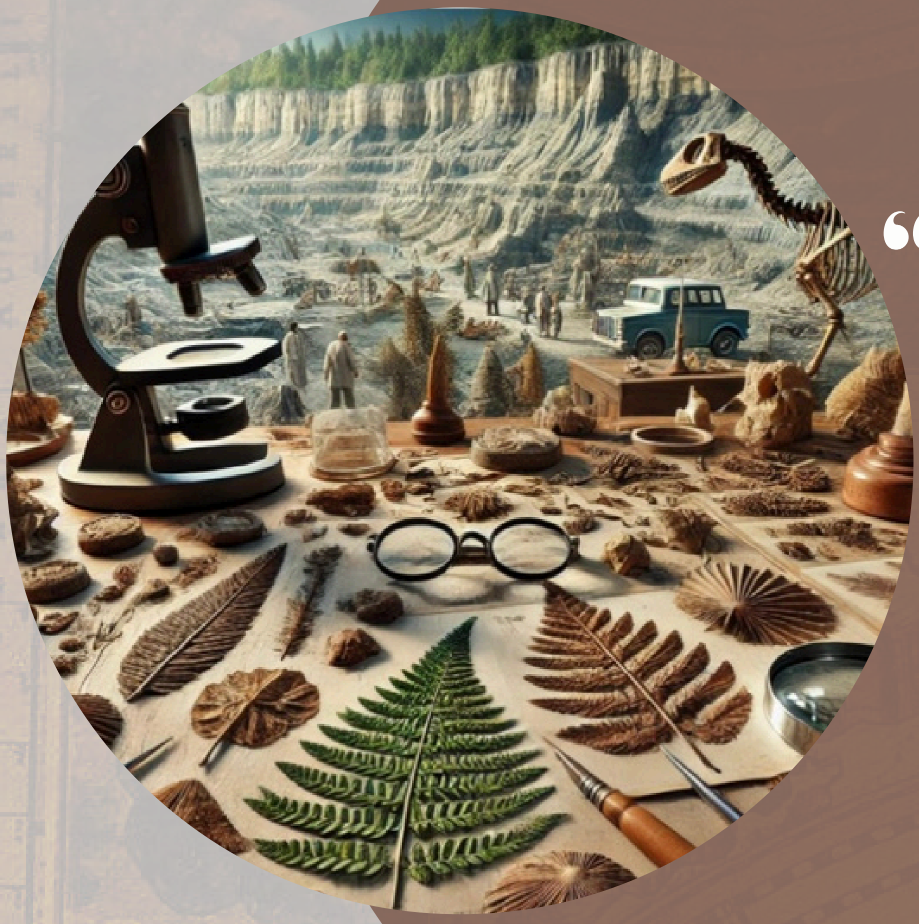
The dramatic shift in global climate forced massive upheaval in ecosystems around the world.Fossil plants and their leaves from the PETM show that ecosystems shifted massively because of the rapid increase in global temperature. But global warming during the PETM did not come from humans. So, scientists today are working on ways to extrapolate information from that period and apply it to the even faster and more drastic events of today.It obviously will take a long time for plants to adapt to changing CO2 levels, but fossil floras allow us to peek into the biosphere of ancient hothouse worlds."Plants with large leaves also lose heat to its surroundings. Finding a large fossil leaf therefore means that most likely this plant was not growing in an environment that was too dry or too cold for excess evaporation or sensible heat loss to happen. These and other morphological features can be linked to the environment that we can quantify.

We can compare fossils to modern floras around the world and find the closest analogy."For example, if a plant has large leaves and it is left out in the sun and doesn't get enough water, it starts to shrivel up and die because of excess evaporationthe morphological method relies on the fact that the leaves of angiosperms flowering hi weplants in general have a strategy for responding to climate.Since different plants thrive under specific conditions, plant fossils can indicate what kinds of environments those plants lived in.

By focusing on the morphology and taxonomic features of 12 different floras, the researchers developed a more detailed view of what the climate and productivity was like in the ancient hothouse world of the Eocene epoch.

-Shrivasugi

Paleoecology



“Reconstructing Ancient Ecosystems”

Paleoecology is the study of ancient ecosystems, focusing on how life evolved and adapted to changes in climate and geography over millions of years. By analyzing fossilized plants and other biological remains, scientists can reconstruct the environmental conditions of the past, shedding light on the Earth's ecological history.

Fossilized plants play a crucial role in this field. Because plants are highly sensitive to their surroundings, they provide valuable clues about ancient climates. For example, plant fossils can reveal whether a region once had a tropical or temperate climate. By studying these remains, scientists can identify shifts in temperature, precipitation, and atmospheric conditions over time.

Paleoecologists also examine fossil layers in rock strata to trace the development of ecosystems. These layers tell the story of how vegetation and environments adapted to natural events like volcanic eruptions or gradual climate shifts. This research not only uncovers how past ecosystems evolved but also reveals how species coped with major changes, such as mass extinctions or the rise of new habitats.

The study of paleoecology has important modern applications. By understanding how ecosystems responded to historical climate changes, scientists can better predict how today’s environments might react to ongoing global warming. These insights are invaluable for conservation efforts, helping us manage ecosystems and protect vulnerable species in a rapidly changing world.

In essence, paleoecology provides a unique window into Earth's history, offering lessons that are highly relevant for understanding and addressing present and future ecological challenges.

–Siddiqui Rabia

Paleobotany and Conservation

‘ In the words of paleobotany, every fossilized leaf and seed is not just a relic of the past but a teacher for the future, reminding us of the delicate balance between life and the ever-changing Earth.’

Introduction: What is Paleobotany?

Paleobotany, the scientific study of fossil plants, serves as a bridge between the distant past and the present, offering critical insights into the evolution and history of plant life on Earth. By examining plant fossils, scientists gain a clearer understanding of how plants have adapted, diversified, and interacted with their environments through geological time. Fossils provide a window into past ecosystems, revealing information about ancient climates, habitats, and the evolutionary relationships between extinct plants and those still flourishing today.

Plant fossils are typically discovered in sedimentary rock formations, such as eroded cliffs, road cuts, quarries, and mines. These fossil localities span the globe, from the icy terrains of the Arctic to the cold deserts of Antarctica. The remnants of ancient plant life, preserved through time, offer clues about Earth's changing environments and climate. Sedimentary layers act like pages in Earth's history book, allowing paleobotanists to unravel the story of plant evolution.

Through the detailed examination of plant fossils, paleobotanists can reconstruct entire plants, place them within taxonomic frameworks, and chart their evolutionary paths. This process not only sheds light on the origins of specific plant structures but also reveals the complex web of relationships that has led to the extraordinary diversity of plant species seen today.

–Shikha Iyer

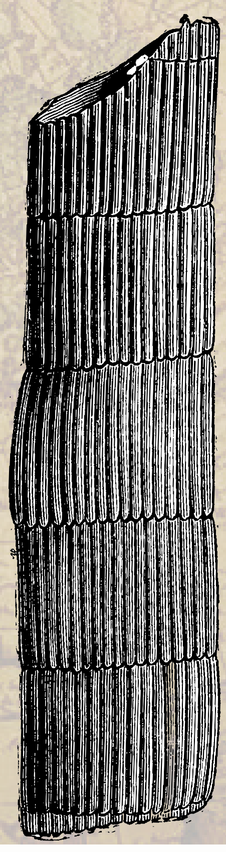
Paleobotany and Conservation

"Objectives of Paleobotany"

The primary objective of paleobotany is to reconstruct ancient plants from fragmented fossilized remains, often scattered across vast geological contexts. Unlike the fossils of animals, plant fossils frequently break apart into roots, stems, leaves, and reproductive structures. Therefore, one of the main tasks for paleobotanists is to connect these disparate parts to form a complete picture of ancient organisms.

By piecing together fossil plants, scientists can assign them to specific taxonomic groups, furthering our understanding of how plant life has evolved. Paleobotany also provides invaluable insights into macroevolution—the large-scale evolutionary changes that occur over long periods. This includes understanding how major plant structures originated, adapted, and diversified, as well as the relationships between extinct species and those still alive today.

Another objective is to trace the evolutionary history of plant groups, such as the differentiation of grasses from other angiosperms, which occurred around 50-60 million years ago. The discovery of such evolutionary milestones helps to establish timelines for the diversification of major plant lineages, enriching our understanding of how the plant world came to be.



-Shikha Iyer

Paleobotany and conservation

"The Nature of Fossils"

Fossils are physical remnants or imprints of ancient life, preserved in layers of sedimentary rock. Fossilized plant materials can range from the direct preservation of plant structures like petrified wood or leaf impressions to indirect evidence like traces left by the movement of roots through the soil. Most plant fossils are found in sedimentary environments such as riverbeds, lakes, and ancient swamps, where sediments gradually buried and preserved the remains.

Coprolite of dinosaur.

Fossil amber with some inclusions.

The study of plant fossils provides crucial data about the distribution of plant species in different eras, their environmental interactions, and the climatic conditions they experienced. Fossil localities scattered across the globe serve as portals into the Earth's deep botanical history, allowing scientists to reconstruct the appearance and characteristics of ancient ecosystems.

"Fun Facts"

Birbal Sahni

Birbal Sahni is regarded as India's "Father of Palaeobotany." He was a renowned Indian palaeobotanist who specialized in studying Indian subcontinent fossils. In India, palaeobotanical research was founded by Birbal Sahni.

Sahni worked on living plant species including *Nephrolepis,Niphobolus,Taxus, Psilotum,Tmesipteris* and *Acmopyle* examining evolutionary trends and geographical distributions. His ability to apply theory to observations and make hypotheses based on observations were especially influential on his students.

–Shikha Iyer

Paleobotany and Conservation

"Paleobotany's Contributions to Evolutionary Biology and Climate Studies"

Paleobotany is a cornerstone for understanding the evolutionary history of plants, offering a timeline for how different plant groups arose, diversified, and adapted over geological time. Through the analysis of fossil records, paleobotanists can estimate when key evolutionary events occurred, such as the emergence of flowering plants or the rise of coniferous forests.

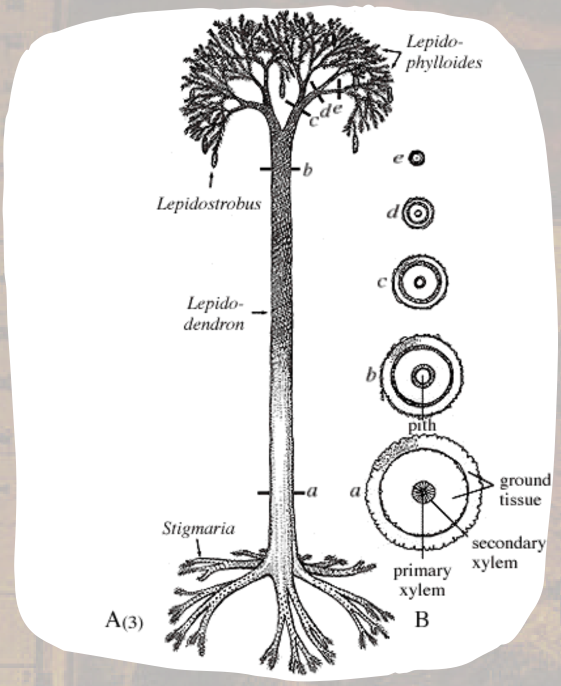
For example, the work of researchers like Daghlian (1981) pinpointed the evolution of grasses to around 50-60 million years ago, providing context for the spread of grasslands and the animals that depend on them. Similarly, the study of fossil palm trees, which expanded and contracted in distribution during the Early Miocene, offers clues about historical global climate changes.

Beyond evolutionary insights, Paleobotany has become an invaluable tool in climate studies. Fossil plants offer evidence of past climatic conditions, enabling scientists to reconstruct ancient environments and understand how climate has influenced plant evolution and distribution. This, in turn, provides a long-term perspective on modern climate change, offering lessons about how plants may respond to ongoing environmental shifts.

-Shikha Iyer

Paleobotany and Conservation

"Preservation and Taxonomy in Paleobotany."



One of the unique challenges in paleobotany is understanding the preservation of plant fossils, which often occurs in fragmented or isolated forms. Fossils may be preserved as impressions, compressions, permineralizations, or even in three dimensions, depending on the environmental conditions at the time of fossilization. Each mode of preservation highlights different aspects of the plant's anatomy, aiding scientists in piecing together the life history of ancient flora.

Because plant fossils are often incomplete, paleobotanists use a system called form taxa, where different parts of a plant (such as leaves, stems, and reproductive organs) are assigned separate taxonomic names. Reconstructing an entire organism from these disjointed parts is a complex but rewarding endeavor. For instance, the Carboniferous scale tree.

Lepidodendron is represented by numerous form taxa, each corresponding to a specific part of the plant:
Lepidophyllodes for its leaves, Stigmaria for its root system, and *Lepidostrobus* for its reproductive structures.

"Subdisciplines and Specializations in Paleobotany"

Paleobotany is a multifaceted discipline that includes several specialized subfields:

1. Biostratigraphy: Using plant fossils to date and correlate layers of sedimentary rock.
2. Palynology: The study of fossil pollen and spores, providing clues about ancient climates and plant communities.
3. Paleoecology: Exploring the interactions between ancient plants and their environments.
4. Dendrochronology: Investigating tree rings in fossilized wood to reveal information about past climates.

These subfields allow paleobotanists to delve into the development and growth of ancient plants, the biomechanics of extinct species, and the origins of major plant structures. Each contributes to a broader understanding of the role plants played in shaping ancient ecosystems and their evolutionary trajectory.

–Shikha Iyer

Paleobotany and Conservation

"Conservation and Paleobotany"

Paleobotany is not only about reconstructing the past; it also holds the key to understanding future environmental challenges. By studying how plants have responded to climate change and environmental stress over millions of years, paleobotanists provide valuable insights into how modern plants may adapt—or fail to adapt—to current climate change.

For instance, understanding the factors that led to the extinction of certain species can inform modern conservation strategies, helping to protect endangered plants and ecosystems today. Paleobotany offers a historical perspective that can guide efforts to mitigate biodiversity loss and predict the impact of environmental shifts on plant life.

"Conclusion"

Paleobotany is more than the study of fossilized plants; it is a window into the dynamic history of life on Earth. By reconstructing ancient plants and tracing their evolutionary journey, paleobotanists illuminate the processes that have shaped the diversity of the plant kingdom. In doing so, they also provide invaluable insights into the resilience and vulnerability of plant species in the face of environmental changes. Understanding this long-term evolutionary history is crucial not only for academic purposes but also for guiding modern conservation efforts aimed at preserving plant diversity for future generations.

-Shikha Iyer

Careers in Paleobotany

Career opportunities in paleobotany span a variety of roles and settings, reflecting the interdisciplinary nature of the field. Here are some key career paths:

"Academic Researcher"

Conduct research on fossil plants, plant evolution, and paleoenvironments at universities or research institutions. This typically involves publishing papers, obtaining grants, and mentoring students.

"Museum Curator"

Manage fossil plant collections, design exhibits, and provide educational programs at natural history or botanical museums.

"Field Paleobotanist"

Conduct fieldwork to collect fossil specimens, often working with geologists and archaeologists to understand ancient environments.

"Paleobotanical Technician"

Prepare, catalog, and analyze fossil specimens in laboratories, supportin researchers in their studies.

"Consultant"

Offer expertise in environmental impact assessments, natural resource exploration, or climate research. Consultants may work with government agencies, oil and gas companies, or environmental firms.

-Arshiya

Careers in Paleobotany

"Science Communicator"

Write articles, create content, or give talks to educate the public and raise awareness about paleobotany and its findings.

"Educator"

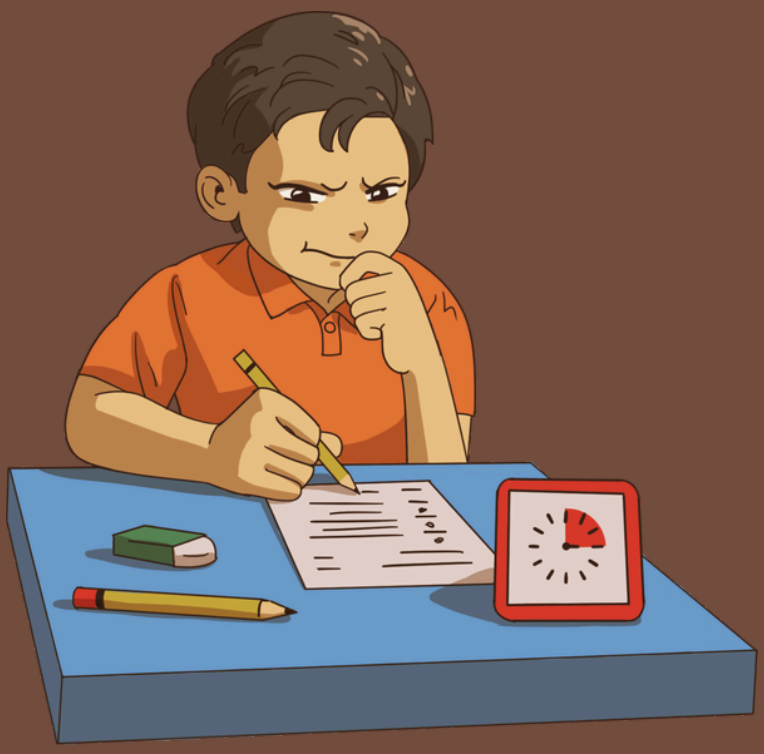
Teach paleobotany or related subjects at educational institutions o through online courses and workshops.

"Environmental Consultant"

Apply knowledge of ancient plants to assess and mitigate impacts on current ecosystems and biodiversity.

These roles often require a strong educational background in botany, paleontology, geology, or a related field, as well as practical experience through internships or fieldwork.

-Arshiya



Exam Alerts

	Exam Name	Exam Organising Authority	Exam Date
1.	CUET(Common University Entrance Exam	NTA(National Testing Agency)	2-3rd week of May
2.	TIFR GS 2025	Tata Institute of Fundamental and Research	December 8, 2024
3.	GATE	INDIAN INSTITUTE OF SCIENCE	1st and 2nd February 2025
4.	JAM	IIT Delhi	2nd February 2025

PHOTO GALLERY

Name: *Gaillardia pulchella*

Location: Mahabaleshwar

Photographer: Selvamathi Kamaraj Nadar

College: S.I.E.S College of Arts, Science and Commerce Empowered Autonomous, Sion(W)

Name: *Dichrostachys cinerea*

Location: Vashi

Photographer: Anith Joshiea

College: S.I.E.S College of Arts, Science and Commerce Empowered Autonomous, Sion(W)

Name: *Hymenocallis harrisiana*

Location: Sion

Photographer: Selvamathi Kamaraj Nadar

College: S.I.E.S College of Arts, Science and Commerce Empowered Autonomous, Sion(W)

Name: *Eichhornia crassipes*

Location: Sion

Photographer: Selvamathi Kamaraj Nadar

College: S.I.E.S College of Arts, Science and Commerce Empowered Autonomous, Sion(W)

PHOTO GALLERY

Name: *Passiflora vitifolia*

Location: Sion

Photographer: Khan Kahekasha

College: S.I.E.S College of Arts,Science and Commerce Empowered,Autonomous,Sion(W)

Name: *Curcuma aromatica*

Location: Sanjay Gandhi National Park

Photographer: Lynn Avila Thomson

College: S.I.E.S College of Arts,Science and Commerce Empowered,Autonomous,Sion(W)

Name: *Zinnia marylandica*

Location: Byculla

Photographer: Riya Renita

College: St.Xavier's College (Autonomous)

Name: *Pleroma urvilleanum*

Location: Byculla

Photographer: Riya Renita

College: St.Xavier's College (Autonomous)

PHOTO GALLERY

Name: *Aechmea gamosepala*

Location: Byculla

Photographer: Riya Renita

College: St.Xavier's College (Autonomous)

Name: *Nerium oleander*

Location: Dharavi

Photographer: Selvamathi Kamaraj Nadar

College: S.I.E.S College of Arts,Science and Commerce Empowered,Autonomous,Sion(W)

Name: *Dahlia pinnata*

Location: Vashi

Photographer: Anith Joshiea

College: S.I.E.S College of Arts,Science and Commerce Empowred,Autonomous,Sion(W)

Name: *Amaryllis belladona*

Location: Vashi

Photographer: Anith Joshiea

College: S.I.E.S College of Arts,Science and Commerce Empowred,Autonomous,Sion(W)

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