Dinosaurs dung and evolution of grass

- Dr. T. V. Venkateswaran

Once upon a time there were no flowers. no roses, no tulips to hold out to your love; no daffodils to adorn your hedge; no jasmine to deck your hair; nor any ponds crammed with lotus and lilies. Indeed flowers are so much a part of our daily lives that we take them for granted. Long long ago, the world consisted of monotonous cold dark green vegetation possessing no other colour. A short time before the close of the Age of Reptiles, at some wayward part of the Earth, there occurred a revolution - first ever flowers bloomed; soon the flowering plant became dominant in the landscape on the four corners of the Earth; and the world was riot of colours.

Today Angiosperms or flowering plants, constitute the dominant vegetation of the earth's surface; flowering plants outnumber the non-flowering by twenty to one. If plant life is just barely possible in any land area, be it freezing poles or blistering desert, most likely they are Angiosperms. They occur abundantly in the shallows of rivers and fresh-water lakes, and in less number in salt lakes and in the sea. One should hasten to add that such aquatic angiosperms are not, however, primitive forms, but are derived from immediate land-ancestors. The range of angiosperms is also wide - from familiar duckweed with no discernable stem or leaf but with simple root system to towering trees with canopy which can host a small village meeting. In between the two extremes is every conceivable gradation, embracing aquatic and terrestrial herbs, creeping, erect or climbing in habit, shrubs and trees, and representing a much greater variety than is to be found in the other subdivision of seed-plants, the Gymnosperms.

Paleobotonists believe that sometime before 140 million years ago, flowering plant*, i.e.* angiosperms, diverged from non-flowering seed plants known as gymnosperms. Fossils of gymnosperms, such as pine trees and other evergreens, go back at least 350 million years. In those days cockroaches were as big as house cats and dragonflies were with the wingspans of modern hawks. Angiosperms appear rather suddenly in the fossil record, just around the cretaceous period (about 145 million years ago). It implies the birth of flowering plants could have occurred anytime between 140 million and 350 million years ago.

Sure, botanists would like to narrow that gap; yet the mystery of flowering plant remains. On the other hand, vegetation is quite an old game. In fact mosses were the first plants to emerge on land some 425 million years ago, followed by firs, ginkgoes, conifers and several other varieties of non-flowering type gymnosperm. In fact, the Plantae, or plants, are one of the most abundant and diverse groups of organisms on Earth, with more than 2,50,000 species known they are second only to arthropods. Plants have a rigid cell wall around each cell and produce their own food by capturing light energy in pigments like chlorophyll. They convert this energy into sugar, starch, and other foods that plants need to survive. Some fossils that appear to be from plants date back to the 488 million years ago (Ordovician), but the first unquestioned occurrences of plant fossils are from the 400 million years ago (Late Silurian). Gnetophytes seed-bearing plants that can grow

as shrubs, trees, or vines and share similarities with both gymnosperms and angiosperms evolved subsequently.

From whence did flowering plant come? How flowering plants were able to diversify so much and spread so rapidly all over the world? How did flowering plants get to be so different from "primitive" land plants, such as mosses, ferns and conifers? The sudden appearance of flowering plants and its rapid colonisation of the entire world is a enigma that goaded even Charles Darwin to grant it as óan abominable mysteryô In fact the puzzle remains as controversial today as ever.

Quite naturally one should turn to fossils for clues; take your shovels, pickaxe and microscopes.

Fossils evidence

What we have is scanty fossils evidence left from the past to reconstruct at least a partial history of the flowering plant. In fact even today the evolutionary history of flowering plants is poorly known, represented by remnant fossils only weakly identified as angiosperms. Some of the earliest types of the flowering plants seem to have emerged about 130 million years ago, although some paleobotanists have claimed fossil evidence as far back Jurassic while others have identified fossilized parts of the earliest flowering plants or angiosperms in 220 million-year old Triassic sediments. Until recently, fossil evidences of early angiosperms were based on vegetative materials and pollen. None of these fossils, however, showed the presence of ovules or seeds enclosed in carpels, the true distinction of the angiosperm lineage. However recently, scientists have discovered in China the oldest, most complete flowering plant fossil yet, with seeds enclosed in the carpels. The 125-million-year-old specimen belongs to a new plant family and provides clues as to how now extinct species gave rise to modern flowering plants. The study suggests that angiosperms - the dominant vegetation in the world today perhaps evolved from aquatic, weedy herbs.

From what is available today as fossil record it appears that flowering plants abruptly appeared out of nowhere about 130 million years ago during the Jurassic period (203-135 million years ago). Based on current evidence, it seems that the ancestors of the angiosperms and the Gnetophytes diverged from one another during the late Triassic (220-202 million years ago). Fossil plants with some identifiable angiosperm characteristics appear in the Jurassic and early Cretaceous (135-65 million years ago), but in relatively few and primitive forms. Inferring from the rich fossil record we do know that by the late Cretaceous, angiosperms appear to have become the predominant group of land plants. The angiosperms underwent a rapid radiation and by the end of the Cretaceous (65-70 million years ago) most flowering plant families had evolved. In fact it is during this time that many fossil plants recognizable as belonging to modern families (including beech, oak, maple, and magnolia) appear in the fossil record. At that time, there is an almost exponential increase in angiosperm diversity, and there does not appear to have been any major extinctions of groups in between. Despite the large numbers of taxa that are known from rather early in this diversification, there is no indication of where the taxa are coming from.

Origin of grass

Take a look at pictures and illustrations depicting dinosaurs. You might find a lush forest of ferns, cycads and conifer but the land itself would be barren. Watch closely. Landscape is without grass, evoking eerie feeling. Yes, until recently grasses were thought to have evolved around 55 million years ago, based on fossil records, after the age of dinosaurs. Grasses are considered relatively advanced flowering plants, and most macrofossils and pollen from grasses appear long after the demise of dinosaurs at the end of the Cretaceous Period (65 million years ago).

Fossil records indicate that after the KT event (impact of meteor on earth that killed dinos), grass became widespread. Barren land became lush with grass. There were many reasons that grass became so successful. First of all, its roots protected the topsoil from blowing or being washed away by the forces of nature. It was able to take advantage of sunlight where trees and taller plants could not. Since grass was a flowering plant, its seeds were protected. And, the shorter roots could up the water before other plants could get to it. Obviously, grass had a tremendous effect on mammalian evolution.

Clue from the Dino dung

The conventional wisdom was challenged and yet another piece in the jigsaw puzzle of evolution was found when Vandana Prasad and her co-workers found phytoliths in the fossilized dung of sauropods that lived in central India about 65 to 71 million years ago. Caroline Strömberg of the Swedish Museum of Natural History, Habib Alimohammadian and Ashok Sahni of the Paleobotony Institute, Lucknow working with Vandana has turned the clock back for grasses. Perhaps grass was there even during the age of reptiles after all.

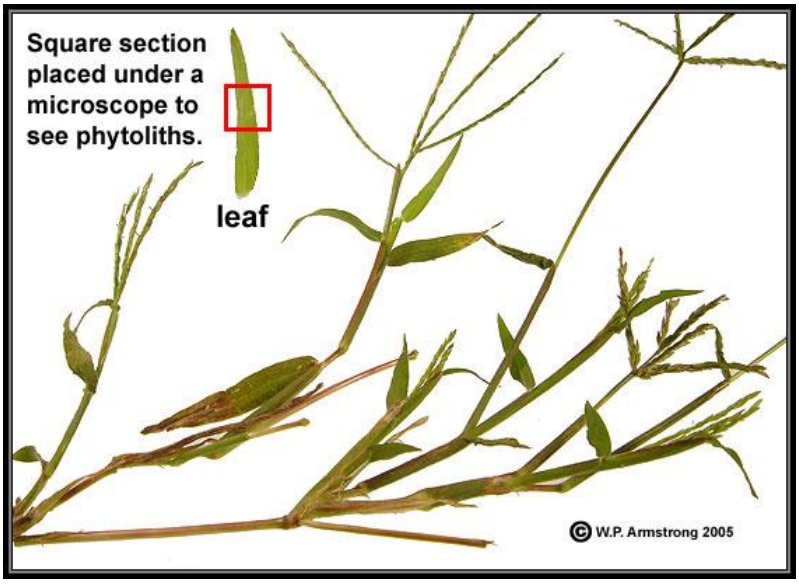
Run your finger along the edge of grass and feel raze sharp rim. Phytoliths are at the root of how a blade of a grass is razor sharp. Phytoliths are microscopic silica bodies found inside the cells of stems and leaves of grasses. Depending on the species of grass, they range from 5 to 100 micrometers in length. Because they are made of a crystalline form of silica called opal, they are very durable and retain their characteristic shapes over millions of years. Different genera of grasses have phytoliths with unique shapes, including square, rectangular, oblong, bilobed, wavy with undulate margins, butterfly and dumb-bell shaped. Like microscopic pollen grains and diatoms, the phytoliths remain perfectly preserved in spaces between soil particles. Phytoliths discovered in dinosaur dung (called coprolites), by Vandana, go to establish that these enormous prehistoric herbivores fed on grasses.

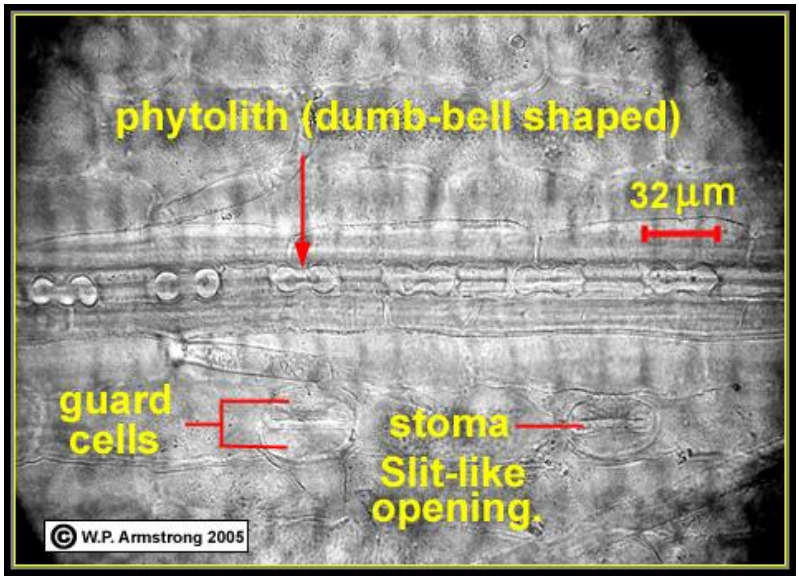
Phytoliths have been an important factor in the evolution of grazing herbivores that feed exclusively on grasses. During the lifetime of an animal that consumes large quantities of grasses, its molars gradually wear down. These animals have evolved high-crowned teeth that in some cases continue to grow from the base as the crowns are worn away. Thus evolution of grass shaped / mediated the evolution of grazers. It is also pertinent to note that the Phytoliths Dr. Vandana found in the Dinoôs dung were similar to

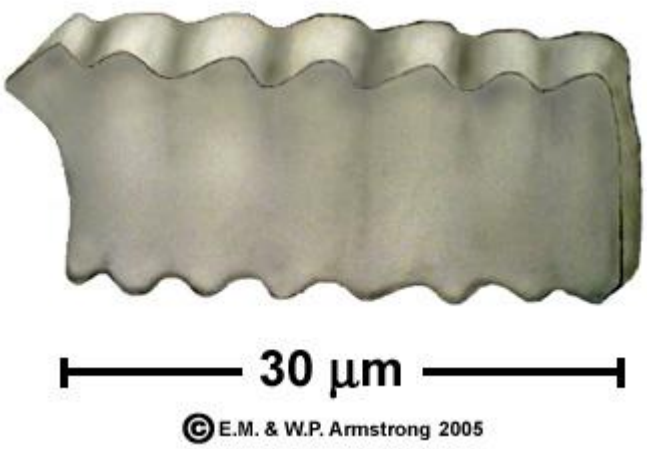
rice and bamboo; indicating perhaps Indian land mass was the site of origin of these plants.

Today's research on grass:

Grass is main food for bullocks, cows, Buffalos, etc. Grass Research Institute in Zansi has developed high protein varieties of grasses viz. Para, Napier, Stylo, etc. Agricultural University at Rahuri (District: Ahmednagar, State: Maharashtra) has done a few modifications in high protein grass varieties named as Yeshwant, Jayawant and so on. These different types of grasses have proved very useful to the animals, in better capacity of working in bullocks and increased production of milk in cows and buffaloes.







(Specific shape of the phytolith gives the grass blade its characteristic sharpness)
