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Proboscideans—The Gigantic Mammals

N.S. Vijayalakshmi and V. Seema

Fossil record an account of vertebratean life through millions of years of earth history as based upon petrified remains that are found in the sediments of earth’s crest.

Fossils are not necessarily direct evidence in the terms of preserved bones or shells, of the organisms they preserve. They may be molds in the rocks, imprints left by the animal (or plant) or by some part of the organism. They may be foot prints made by an animal, they may be preserved structures that were built by an animal during its life time, such as nests or tubes. Fossils are found in various forms. The true understanding of fossils was reached by (among others) the great and accomplished Florentine Leonardo Davinci. The significance of fossil as an evidence for evolution was also released by Charles Darwin.

The proboscideans have been through out their life history, large and gigantic mammals of the forest and the plain.

Elephants are familiar and fascinating creatures to all of us. These giant mammalian creatures are still living in considerable number in Asia and Africa and widely domesticated by man. Modern elephants are the last representatives of these dying group and it is quite possible that even without the intervention of man as a destructive agent, they may be very well be on their way in extinction within the next few thousand years because their number is limited at present time with two genera, each with a single species, one in Asia and in Africa. It is suspected from the knowledge of modern elephants alone that their ancestors and collateral relatives inhabited the world in large numbers through the middle and later portions of Cenozoic era.

The remains of these extinct animals were collected by the ancient Greeks and Romans as curious objects, worthy of preservation and a leg bone of a fossil elephant was among the treasures of the ilassalan Indian of Mexico.

The fossils show that at various times during the Cenozoic era, the proboscideans lived on all the continents of the world, except Australia. During the later phases of the Tertiary period, these great beasts evolved along numerous lines of adaptive radiation, some of which continued into Pleistocene times. The phyllogenetic study of proboscideans is very complex since there was a great deal of parallel evolution within the order of mammals.

The Moeritheres

The first proboscideans known from the fossil record were moeritheres named from the typical genus, Moeritherium, that lived in Egypt during the late Eocene times. They were heavily built animals about the size of pigs, with long bodies and stout legs that terminated in broad, spreading feet, having flat hoofs on the end of the toes. The tail was short. All in all the body of Moeritherium was generalized about what might be expected in a medium-sized, heavy footed ungulate of Eocene age.

Skull long with the eye set far forward in front of the most anterior premolars thus making the cranial region of skull very much elongated. The cheek bone was also very long. Back surface of the
Proboscideans—The Gigantic Mammals

skull-occipital was broad and provided space for the attachment of strong neck muscles. The lower jaw was deep, and its back portion, the large ascending ramus, extended up so that the articulation between the jaw and the skull was placed high above the level of the teeth. The second upper and lower incisors were enlarged. First incisors were very small. The third incisor and canine were small teeth and were completely suppressed in the lower jaw. The external nostrils were located in front of the skull having a thick upper lip. There was no proboscis.

From these basic proboscidean characters, proboscideans have evolved along several lines of adaptive radiation during the middle to late Cenozoic era.

Certain dominant trends in the evolution of proboscideans are:
1. Increase in size.
2. Lengthening of the limb bones and the development of short broad feet.
3. Growth of the skull to extraordinarily large size.
4. Shortening of the neck.
5. Elongation of lower jaw. In later proboscideans, there was secondary shortening of the jaw.
7. Hypertrophy of second incisors to form tusks used for defence and for fighting.
8. Limitation of specialization of cheek teeth—adaptation for chewing and grinding.

Evolutionary Trends
1. Increase in size and weight
2. Development of proboscis and upper lip
3. Place of origin was Africa and then migrated to America and Eurasia.

Meeritherium
Lived in Cairo, Egypt during Eocene period about 58 million years ago. It was a swamp dweller and size of a pig. It had no proboscis. A diastema was present and the snout was elongated.

Phiomia
Phiomia lived in Oligocene epoch in the Siwalik hills of Africa. It had a size double than that of Meeritherium and tusks were present in both jaws.

Dinotherium
It formed of a side line of elephant evolution. It lived during Miocene and became extinct during Pliocene. Proboscis was present. No tusk in the upper jaw.
Paleomastodon

It was on the main line of elephant evolution. It lived during Oligocene. Proboscis was short. Upper tusks were elongated.

Mastodon

Had the size of an elephant. They lived from upper Oligocene to Pleistocene. They became extinct during Pleistocene. It had long upper tusk. Miomastodon lived during Miocene and Pliomastodon lived during Pliocene.

Bunomastodon

It has long proboscis and tusks on both jaws.

Bunomastodon

Trilophodon

It lived during Pliocene. It was about the size of modern elephant. It had four tusks. Upper tusks were more elongated and lower tusks were short.

Tetralophodon

They lived during Pliocene. They had a proboscis like modern elephant. Body was covered by a dense coat of hair.

Stegomastodon

It was a side line of evolution. It lived during Pleistocene. It has a well developed upper tusk and rudimentary lower tusk.

Stegolophodon

It was on the main line of evolution. Lived during Pliocene.

Stegodon

Lived during Pliocene. It had long proboscis and long upper tusk.

Mammoths

They were like doern elephants but were extinct. The body is covered with the hairy coat.
Modern Elephants

Two genera of modern elephants belonging to the family Elephantidae exists today. They are
(i) *Elephas africanus* (African elephants)
(ii) *Elephas indicus* (Indian elephants)

African elephants differs from the Indian elephants
(i) by the presence of tusks in both sexes
(ii) also by the presence of large pinnae

Elephants have polyphylectic origin. Numerous fossil forms are available in different regions of the world suggests that these animals were once world wide distribution but to-day they are limited by only two genera in two regions may be due to some geological causes.

Notes and References

Study of the Early Amphibians with Reference to Geological Period

V. Seema, N.S. Vijayalakshmi and L. Lakshmi Bai

The descendants of crossopterygians ventured out of water on to the land for the first time at the end of the Devonian period and became the amphibians, first land living vertebrates of to-day.

The first formed amphibians are known as Ichthyostegids, differ greatly from its nearest crossopterygian ancestors. They were considered as connecting links between advanced crossopterygians and early amphibians. This group had a mixture of piscine and amphibian characters.

The ichthyostegids were succeeded by a main branch, labyrinthodonts. They originated in the lower carboniferous period, a period after Devonian. Labyrinthine teeth were present, hence the name Labyrinthodontia. The Labyrinthodonts were divided into 2 main branches, the Embolomelii and the Rhachitomi. The embolomelii gave rise to the reptiles whereas the rachitomii gave rise to the anurans. Eryops is the typical example of rachitomi. It was an intermediate form between the labyrinthodonts and anurans. From this eryops, frogs like anurans had evolved.

From the ichthyostegids arose another group of amphibians called the Lepospondyla. They were small primitive amphibians. This group might have given rise to urodela. Apoda might have also arisen from this group.

Ichthyostegids were the earliest known amphibian forms. The problem of respiration outside the water has been solved by their ancestors. The crossopterygian ancestors had lungs. The first land living vertebrates primarily air breathing animals, using their lungs for respiration, although their young ones are gill breathers.

The first amphibians faced the problem of retaining the body fluids when they were no longer immersed in the water. The ichthyostegids were ventured far away from water and returned frequently to stream and lakes. First amphibians retained the scales that have covered the body in their fish ancestors. It is evidenced that amphibians lived in the Permian period developed tough skins. The outer coverings become increasing, efficient for preventing evaporation of body fluids served as a tough coat. To contend with increased effects of gravity-amphibian develop strong back bone and short limbs. The rings in the centre of the vertebrae in the crossopterygian became transformed into interlocking structures with the aid of muscles and ligaments. Again vertebral column was supported by girdles-girdles in turn supported by limbs.

New Method of Locomotion

Locomotion means to hold up the body in counteraction to the force of gravity. Locomotion propel the animal across the land. Reversal in locomotor functions between the fish and the amphibians. In fish locomotion was effected by the body tail, and fins. In the early land living vertebrates the tail was attenuated to become in some degree as a balancing organ. Paired appendages serves as the chief locomotor organs.
This pattern initiated by the early amphibian continued with many variations through the evolution of the land living vertebrates.

Problem of Reproduction

Fishes deposit their unprotected eggs in water. Though amphibians made several great advances to their adaptations on life on land they never solved the problem of reproduction themselves away from moisture. They forced to return to the water or among some specialized forms to moist places, to lay their eggs.

Designs for Life on Land

Ichthyostegids appeared at the end of the Devonian period. Amphibians of Mississippian and Pennsylvanian reached the point of stabilization, four legged vertebrates, Tetrapods were established.

Ancient Tetrapods

Labyrinthodontia  
(Structure of teeth)  

Stegocephalea  
(Solid-roof skull)

In the ichthyostegids the external nostrils were far down on the margins of the skull and separated from the internal are now in the front part of the pallial region were separated from them, consequently a well defined nasal passage. Spinal column is efficiently designed for supporting the body of the animal out of the water. Development of strong interlocking joints. Pectoral girdle-U shape, pelvic girdle-V shape. Pectoral girdle and pelvic girdle to provide strong support. Development of tympanic notch for the accommodation of eardrum.

The Labyrinthodont Amphibians—Anthracosaurs

Among the early descendants of the ancestral, ichthyostegids were the amphibians known as anthracosaurs, which appeared during Mississippian times.

The Labyrinthodont Amphibians—Temnospondyls (Rhachitomes)

The earliest temnospondyls are contained within a large and varied labyrinthodont group, designated as the rhachitomes. These amphibians, originating in the Mississippian period as direct descendants of the ancestral ichthyostegids, were most characteristically developed in the subsequent Pennsylvanian and Permain periods. In each vertebra the neural arch was supported by vertebral both the intercentrum and the pleura Centrum. This association of bones formed the rhachitomous vertebra, probably the basic, central type of vertebral structure among the labyrinthodonts, since its initial stages are indicated in the ichthyostegids. The rhachitomes became the dominant amphibians of Permain times and of these the genus Eryops from the lower Permian Sediments of Texas can be described as a typical example of the group. Eryops originated on the late Carboniferous and evolved during Permian about 250 million years ago.

Eryops, six feet or more in length, was a heavily built animal. It had a very large, broad, and rather flat skull. The opening of the palate seemed to go along with the flattening of the skull in eryops. Another contrast with the anthracosaurs was the solid joint between the palate and the brain case in eryops. There were strong labyrinthodont teeth around the margin of the jaws and some very large teeth in the palate.
The vertebral column was extraordinarily strong an indication that Eryops was well adapted for life on the land. The shoulder girdle was heavy, with the scapula and coracoid dominant. The limbs, though short, were very stout. It is quite apparent that eryops was a rather well adapted land animal, even though it probably wield away many languorous hours in the water. Eryops was probably a fish eating amphibian, but it must have been rather aggressive, and it may have supplemented its diet by preying upon land-living animals.

The rhachitomes evolved along various lines of adaptive radiation during the Pennsylvanian and Permain periods. There were numerous large semi-aquatic and land-living types like cryops, there were others that became specialized for quite different modes of life.

In certain late Pennsylvanian and early Permain deposits in Europe the skeletons of very small labyrinthodonts, commonly known as branchiosars, have been found. The branchiosurs frequently show indications of fossilized gill arches.

The rhachitomous amphibians enjoyed a long and succeed sojourn over much of the earth's land areas during Permain times. A few rhachitomous types known as trematosurs which persisted into the early portion of the Triassic period. Trematosurs soon died out, leaving the stereospondyls as the dominant Triassic amphibians.

The Labyrinthodont Amphibians—Temnospondyls (Stereospondyls)

The stereosponds were highly specialized aquatic types that probably seldom ventured on to the land. The stereospondyl pattern of evolution was certainly a successful one for the Triassic period, and these animals became the most common and widely distributed of continental vertebrates. They continued their evolution right up to the end of the Triassic period, and then became completely extinct.

The vertebral central in the stereospondyls were reduced to simple blocks composed of the intercentra alone, above which were the neural arches and spines. Consequently there was a common trend among these amphibians toward an increase in size, with the result that some stereospondyls surpassed their large Permain ancestors, to become the largest amphibians ever to live. The skill increased at a greater rate than the body, flatness in the skull was accompanied by flatness in the body. Increase of cartilage and reduction of bone in some parts of the skeleton and the braincase became cartilaginous.

Even more aberrant than the stereospondyls were the plagiosaures, typically represented by a few genera of late Triassic age. These grotesque amphibians were characterized by an extremely flat skull, which was remarkably broad as compared with its length. The body also was flat and broad, and the limbs were small. One genus, at least (Gerrothorax), had persistent external gills, like the ones in certain modern salamanders. These labyrinthodonts represent a bizarre line of temnospondyl evolution that carries to extremes some of the evolutionary trends seen in the stereospondyls. With the close of Triassic times, when many land-living vertebrates became extinct, the stereospondyls and plagiosaur also became extinct. The long and successful history of the labyrinthodonts came to an end with their disappearance.

Trends in Labyrinthodont Evolution

Evolution in the labyrinthodonts was directional, that it proceeded along certain definite courses from the end of the Devonian to the end of the Triassic periods. In general, it is possible to trace the rise and the development of these amphibians along two evolutionally trends. From fish ancestors through the primitive ichthyostegids, the labyrinthodonts continued to evolve on the one land to a high
point exemplified by the strongly terrestrial, rhachitomes of the Permian, after which there was a secondary return to the water, as seen in the large Triassic stereospondyls. On the other hand the labyrinthodonts would seem to have evolved from primitive types toward a permanently aquatic mode of life, as shown by the anthracosaurs. Certain members of this line were destined eventually to lead to the reptiles, as we shall see.

The Lepospondyls

They shared the land, the streams and the ponds with other amphibians, which can be called lepospondyls. The lepospondyls were a highly varied group that appeared as early as the Mississippian period reached the height of their evolutionary development in the Pennsylvanian and Permian periods, and then, with the close of Palaeozoic times, became extinct.

Many of the lepospondyls remained as small, generally primitive amphibians, suited for life in the underground at the edge of the water, or to life in the swamps.

The most numerous and varied of the late Palaeozoic lepospondyls were the amphibians belonging to the order known as the Nectridia. Diplocaulus, from the Permian beds of Texas, is a well-known genus that probably represents the culmination of evolution development. It was water-living amphibians.

The Lissamphibia

The modern denizens of our tanks and streams are grouped within a sub-class, the lissamphibia. The frogs and toads were generally considered the direct descendants and the rather close relatives of the labyrinthodonts, while the other modern amphibians-salamanders and the tropical urodans-were regarded as of lepospondyl relationships.

Notes and References

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A FEW ENDANGERED MAMMALIAN FAUNA OF THENMALAI FOREST

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ABSTRACT

Wild wealth was once abundant in all the Indian forests, especially in Kerala forest. Now this treasure is gradually decreasing and facing the threat of extinction mainly due to the destruction of their habitats. The dwindling of the habitat results in the reduction of the wild life which greatly affects the ecological balance of the nature.

Western ghats is unique for its various floral and faunal diversity. Thenmalai, the Southern part of western ghats is also famous for its varied species of mammalian bio-diversity. Some of this mammalian fauna are endemic to this particular area alone. A few of these endemic species are on the verge of extinction. Poaching, hunting and other illegal activities leads to the dwindling in the population density of this wild fauna.

Wild population of Lion-tailed macaque is a highly endangered species. Brown palm civet cat is decreasing in number due to human interference. Brown mongoose, Ruddy mongoose, Indian mole cat are also on the verge of extinction due to the destruction of their natural habitat. Conservation of wild fauna and flora enrich the beauty of nature and bring biological diversity. This habitat need more attention. The threatened species should be protected.
AVIAN BIO-DIVERSITY IN THENAMALAI FOREST

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ABSTRACT

Kerala is blessed with varied forest such as Southern tropical wet evergreen, Southern tropical semi evergreen, Southern tropical moist deciduous, Tropical dry deciduous, Temperate shola, Grassland and Wetland and has a rich biological diversity.

Thenamalai, a part of Kerala situated in the Southern part of Western ghats has a high degree of avian bio-diversity. From a survey report, Kerala forest department reported 245 species of avian fauna including migratory, endemic and endangered species. The rich diversity of birds transforms into their dominance in this region.

The activities of the people in the enclosures could be a hindrance to the birds. Uncontrolled human activities, excessive sound pollution, hunting, contamination of boat oil within the reservoir etc. have a direct impact on the bird population.

The conservation efforts to prevent the extinction of Avian Bio-diversity are also discussed.
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Crustaceans are often affected by shell disease. Occurrence of this disease is due to the interaction of facultative pathogens and environmental stresses. Bacteria belonging to the genera *Beneckea*, *Vibrio*, *Pseudomonas* and *Aeromonas* were identified as associated with the shell disease. These bacteria have the capacity to produce extra cellular lipases, proteases and chitinase that are capable of damaging the cuticular layers of the exo-skeleton. These bacteria originated through exoskeletal structures due to the wound formed by the injuries and due to the mechanical trauma or physiological or nutritional woes. Manifestation of shell disease includes formation of black spots, erosion and destruction of exoskeletal structures. Depending upon the severity of infection, the disease causes morbidity and mortality.
National Seminar on
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Nitrate forms one of the important nitrogenous plant nutrients. High concentration of nitrate may occur in coastal water due to the use of agricultural fertilizers and discharge of industrial and domestic effluents. Nitrification is known to be completed in coastal waters.
Pollutants, whether domestic or industrial, when released into the water body become a part of the environment and of the organisms inhabiting the ecosystem. Heavy metals form one of the important pollutants released into the water bodies. Increase in the Cu content of the aquatic ecosystem may be due to land run-off, industrial wastes, river discharges or domestic wastes. Variations in Cu pollution is discussed.
CADMIUM POLLUTION IN COASTAL WATERS OF TUTICORIN

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ABSTRACT

Industrial and municipal wastes are the main sources of cadmium pollution in aquatic ecosystem. Cadmium concentration is high in coastal waters mainly due to domestic effluents, fresh water run-off, tides and currents. Abundance and distribution of cadmium in Tuticorin coastal waters are discussed.
VERMICOMPOST AS A SOURCE OF BIO-GAS

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ABSTRACT

Anaerobic digestion is a process whereby organic matter is broken down by microbial activity leading to the production of bio-gas. Bio-gas is highly economical and the gas has all the advantages of gaseous fuel such as cleanliness of utensils and the surrounding areas and absence of smoke, dirt etc. The digested slurry released from the fermenter is a good organic manure for agriculture.
Studies on the Infestation and Effects of Neomurraytrema

Tengra on Mystus Keletius

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Although a number of fish species have been introduced in fresh water bodies with a view of enhancing the species spectrum their number abundance and diversity are greatly altered owing to several factors. Among the factors that limit the biodiversity of organisms, the most important and vital factors are the parasites and diseases as they are highly detrimental to fish population both in wild and in cultural systems. The present study reports the infestation of the monogenetic trematode Neomurraytrema tongra on the freshwater catfish Mystus kololius.

*M. kololius collected from a freshwater body were found infested by monogenia and its prevalence was 66.1 percent and the intensity was 8.1. While the regional distribution did not show any significant difference, the sectoral distribution showed a marked difference.

Detailed investigations were carried out on infestation with a view to understanding the nature of the host-parasite relationship. The aspects studied in detail include prevalence and intensity of infestation as a function of different periods, size and sex of host; impact of parasitism on length-weight relationship, relative condition factor, feeding intensity and oxygen consumption. The results obtained were statistically treated and discussed with related literature.

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